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JUL 16 1928

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Are they going to properly safeguard the health of the bathers this summer? Are they going to be clean, attractive, healthy places to swim? Is the water going to be filtered,—and sterilized with liquid chlorine to prevent all possibility of the transmission of water borne disease?

A Committee of the American Public Health Association after investigation reported that "from all available information the addition of chlorine—by the us of proper apparatus, is today the most satisfactory method of pool disinfection." Higher endorsement could not be had.

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As specialists in swimming pool sanitation, we will be glad to send one of our engineers to discuss the subject of sterilizing equipment.

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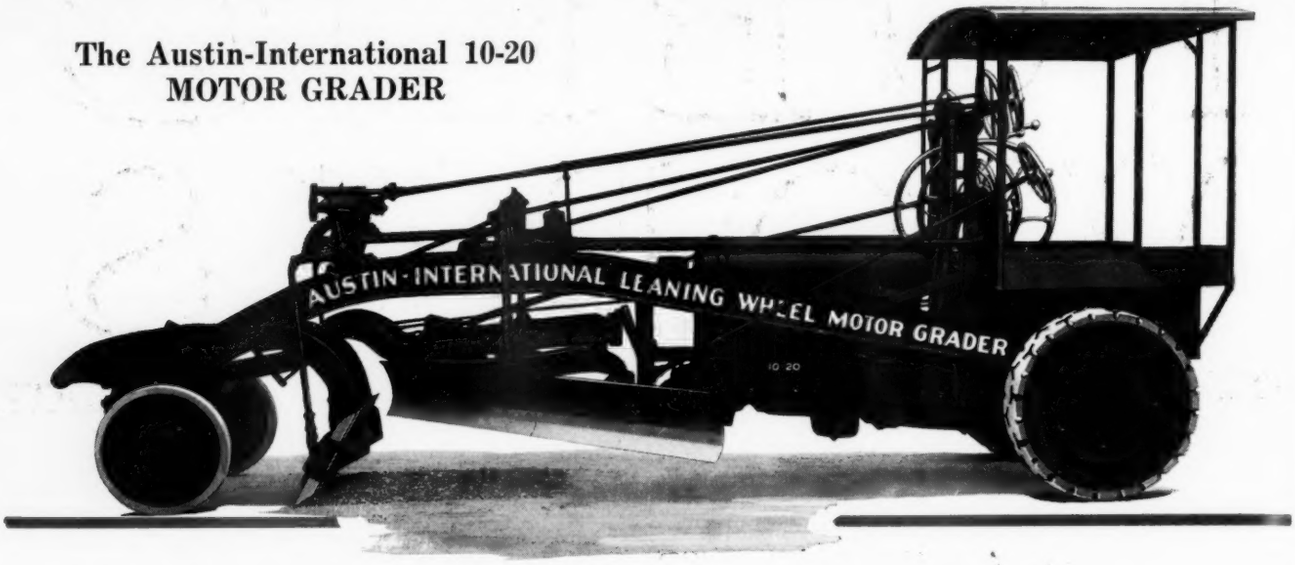
THE AUSTIN-WESTERN LINE

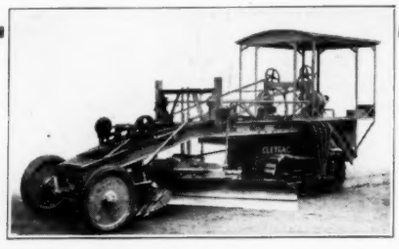
The Austin-International 10-20 MOTOR GRADER



The Austin-International 10-20 is an excellent all-round machine for public officials. Among its best features are leaning front wheels—an exclusive Austin feature—cut steel raising gears in dustproof housings and ball and socket joints on the raising rods to eliminate lost motion. Front or rear scarifier attachments are furnished on special orders; also V-shaped snow plow attachments, special snow blades and a rear crawler tread in place of rubber tired wheels. Regular equipment now includes a cab for the operator's protection.

The Austin-International 15-30 is a heavier machine with the extra weight and power needed to cut right down to the bottom of the corrugations on the hardest gravel roads.

The Austin-Fordson, the lightest of the Austin Motor Graders, has almost all the features of the Austin-Internationals and is an excellent general purpose model.



The Western Motor Grader with Cletrac and Caterpillar Tractor Power

The Western Motor Grader is an attachment for the No. 20 "Cletrac" or 2-ton "Caterpillar" Tractor. It is easy to detach when desired. A maintenance and grading unit for even cutting and smooth surfacing of roads, it is designed for use with a 12-ft. blade. The weight of the rear end of the frame is carried in a way that gives the track a greater grip on the ground, and relieves the tractor of a great deal of strain. The self-cleaning "A-shaped" scarifier attachment has many uses. The up-and-down motion of the blade has been eliminated due to its position halfway between the front and rear pivotal points.

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Through steadily improved design, Austin-Western has made available to the officials of cities and villages motorized road equipment that can be put to the widest possible use. Austin-Western Motor Graders are particularly successful with the ditching and grading jobs that constantly need to be done on village streets and country roads. Men, long experienced in road construction and maintenance work, have designed Austin-Western motorized road equipment and are responsible for its leading position in the field.

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"MOST MILES FOR YOUR ROAD DOLLARS"

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JULY, 1928

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CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 59 July, 1928 No. 7

Maintenance and Management of State Highway Equipment

How the State of Pennsylvania looks after more than five thousand pieces of equipment used in maintaining its highways.

By W. A. Van Duzer*

The Department of Highways of Pennsylvania has under its jurisdiction more than 12,100 miles of highways, over 8,400 miles of which is of the the hard surface type. To maintain these highways and keep them in condition for travel by the motoring public 365 days of the year necessitates a plant investment in excess of $4,000,000 consisting of over 5,000 individual units.

Before we go into further detail in the operation of this equipment, it is necessary to visualize the method of organization of this department. The state is divided into eight divisions of approximately equal area. In each division all construction and maintenance activities of the department are under the jurisdiction of a division engineer. Reporting to each division engineer are from five to eight maintenance superintendents, each in charge of the maintenance operations of a particular county; or, in the case of small counties, in charge of the work of several counties. In all, fifty-two maintenance superintendents report to the eight division engineers.

*Assistant Chief Engineer, Pennsylvania Department of Highways.

Each of the maintenance superintendents is personally responsible for the operation of all maintenance equipment assigned to his district. All department-owned equipment (and this covers all equipment that is not included in the class of small tools) is assigned to the various superintendents as needs require on a rental basis, so much being charged for each piece of equipment per hour, or per day. These charges are made against his authorizations for maintenance work and the money so received used to operate and maintain storage sheds and garages located throughout the state in addition to the central garage at Harrisburg, and to cover all repairs, interest, depreciation and maintenance upon departmental equipment.

FIELD GARAGES

To house the equipment properly and to provide shop facilities at convenient points in each of the maintenance districts, sixty-five buildings have been erected throughout the different maintenance districts in the state. These buildings are standardized as to dimensions, each of them

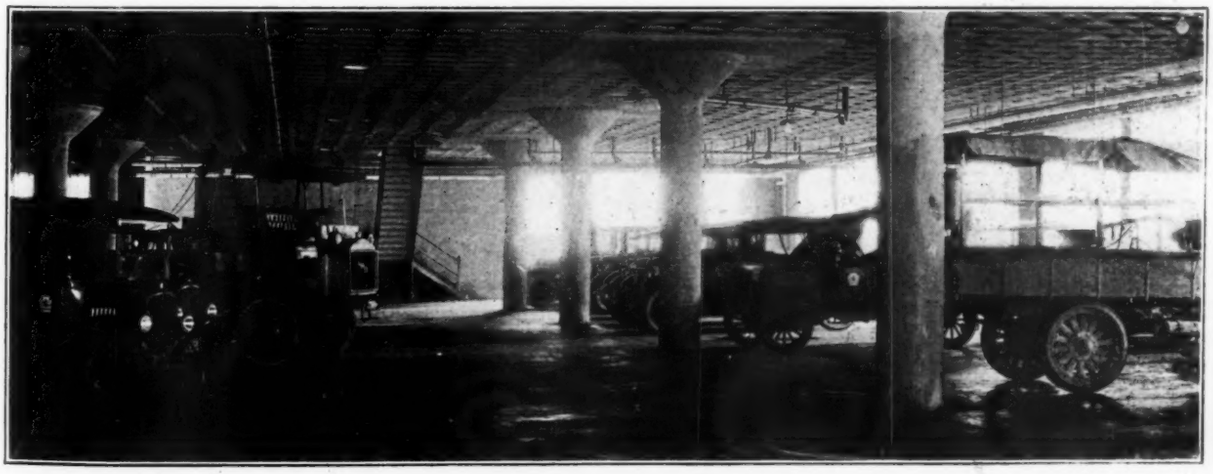


FIG. 1. GROUND FLOOR, CENTRAL REPAIR SHOP STORAGE AND SERVICING EQUIPMENT.

FIG. 2. TYPICAL FIELD STORAGE SHED AND GARAGE.

being forty feet wide and the length being in multiples of sixteen feet, the average building being about forty feet by ninety-six feet. The size of the building, of course is dependent upon the amount of equipment to be kept in storage, the number of men required to handle the winter overhauling of equipment and the number of snow plows operating out of this building during the winter months. These buildings have structural steel frames, sheet metal sides and roof, and are set upon concrete foundations with concrete floors. In one of the buildings in each maintenance district there is a field shop thoroughly equipped to do such minor repair work as may be necessary to keep the state's equipment in economical operation. Figure 2 is typical of one of these maintenance storage sheds.

In order that each of the maintenance superintendents may be in close contact with his equipment, office quarters have been provided in these buildings. During the winter months the offices are open twenty-four hours a day, as watchmen are kept on duty in order to observe weather conditions and sound the snow alarm in order to get snow removal operators on the roads in case of snow during the night.

CENTRAL REPAIR SHOP

A central shop and garage has been established in Harrisburg to handle all major repairs and complete overhauling of equipment. This is a two-story concrete building containing forty-two thousand square feet of floor space and is modernly equipped throughout. Located in this building is the central office of the Equipment Bureau, which maintains records for all department-owned equipment.

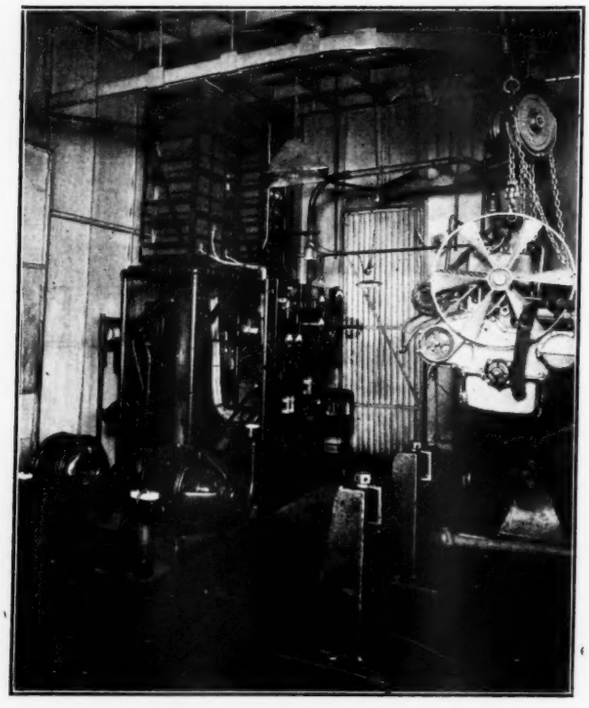


FIG. 3. DYNAMOMETER ROOM, CENTRAL REPAIR SHOP. RUNNING IN AND TESTING REBUILT MOTORS.

The lower floor of the garage has facilities for completely overhauling and servicing passenger cars, in addition to equipment for spray painting, brush painting, battery charging, magneto repairing, upholstering, top building and car washing. Figure 1 is an interior view of the ground floor of the central garage.

The upper floor handles overhauling and major repairs on all equipment other than passenger cars. Since the majority of the work is on motor trucks, the shop space is laid out for repairing motor vehicles on a production basis; and to more efficient carry on the work, the floor is divided into groups covering motor, transmission and differential, chasis, radiator, dynamometer, blacksmith, machine shop, and salvage.

A unit replacement system is used, which has materially reduced the time necessary for overhauling. This is accomplished by keeping overhauled units on hand at all times, ready to replace defective units on vehicles brought in for overhaul.

An automatic air compressor supplies air for pumping tires, cleaning, spray painting and operating pneumatic tools.

The expense and fire hazard of using gasoline as a cleanser in the shop are avoided by the use of a cleaning tank where all parts are boiled in a soda solution in order to remove all grease and scale.

A dynamometer, shown in Figure 3, is used by the department for running-in and testing rebuilt engines. Any defects in an engine show up on the test block and consequently preclude the possibility of an engine failing after it has been assembled in the vehicle, thereby contributing much to the efficiency of the repair work performed in this shop.

Parts of both floors in the central garage are securely partitioned off and used for stocking parts, not only for the equipment being overhauled in the central garage, but for all equipment operated throughout the state. Parts are issued to the field garages on requisition and twenty-four hour service is maintained at all times on more than 16,000 spare parts carried in stock.

A perpetual inventory system is used for keeping these stock records and a shortage of any part is practically unknown.

INSPECTION

Monthly inspections of all equipment are the basis of undertaking repairs other than the minor replacements and adjustments made by the operator in the daily routine of keeping his equipment service. Eight equipment inspectors cover the entire state and report all major equipment monthly, using a special form, a sample of which is shown in Figure 4. This report is the foundation of the inspection system and upon it all ac-

FIG. 4. VIEW OF REPAIR FLOOR IN FIELD GARAGE.

tion is based. The inspector keeps one copy of tion is based. The inspector keeps one copy of this report, sends one copy to the Equipment Division, in the central office, one copy to the superintendent to whom the equipment is assigned and a copy to the division engineer to whim the superintendent reports. The report shows whether or not previous recommendations for improving the condition of the equipment have been carried out, and as a result the Equipment Division is in a position at all times to follow up repairs that are not being made in accordance with the inspector's recommendations. The inspector recommends the conditioning necessary on each piece of equipment and indicates whether it is a local repair job, to be handled in the field shop, or one for the central repair shop at Harrisburg.

When complete overhauling is necessary, the equipment is transferred to the central garage where the shop procedure is one of considerable detail, but is of the kind familiar to shop management, consisting of clock-punched job cards and tags, job control charts, progress and completion reports.

INSURANCE AND ACCIDENTS

Full insurance on all equipment is absolutely essential. All motor vehicles in particular are covered by fire, public liability and property damage insurance. Fire insurance is required of all equipment and steam boiler insurance of all steam power equipment. A very close accounting of this insurance is required so that adjustments of policies may follow promptly when equipment is added to, or removed from service. Special forms insure correct and prompt reports of accessories and discontinuance to the insurance companies.

Full reports of accidents are equally important and this refers to both the department equipment and to other property losses in which department equipment may be involved. Special forms for recording these accidents are employed so that damage adjustments may be prompt and that personal liability, particularly for motor vehicle accidents, may be determined.

A summary of accident reports is made annually to show the location, personal liability, damages, causes, etc.

EQUIPMENT CONTROL

A registration section in the Harrisburg shop keeps a record of the status of all department-owned equipment, showing the kind, type, date purchased, price paid, serviceability, location, etc.

Six metal buildings sixty by one hundred and sixty feet in size are located in Harrisburg and are used exclusively for dead storage of equipment and parts.

With the frequent reports of inspection and repairs, a fairly close inventory of the equipment condition is had at all times. On the first of each year, however, an inventory is made showing the location and condition of each piece of equipment, giving its appraisal value and its probable remaining life and recommending its continuance in service or its replacement. If condemnation and replacement are advised for any unit, a special report is required which will make clear its life and service and which recommends whether or not replacement should be by the same make and kind of machine. All condemned equipment is promptly sold and the only equipment retained by this department is that which is operating economically.

Such a system of equipment control and maintenance results in consistently low operating costs, a flexibility of organization which permits equipment to be concentrated promptly at points where it is most required, and finally results in more economic and efficient maintenance of all types of highways.

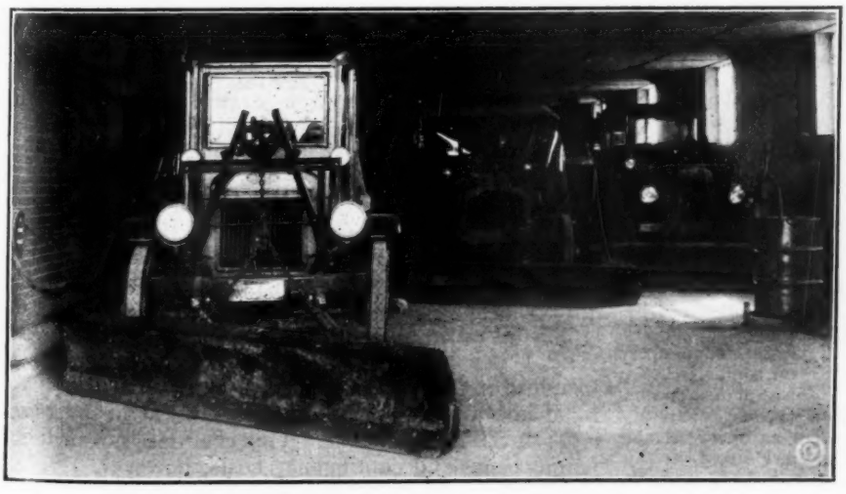


FIG. 5. SNOW REMOVAL EQUIPMENT IN DEAD STORAGE.

EQUIPMENT RENTAL RATES

The charge for Fords is 40c an hour, for Chevrolets 50c, and for the other automobiles from 90c without operators to $2.50 with operator. (In general, charge for operator is 40c an hour). These cars include Buick, Cadillac, Dodge, G. M. C., Hudson, Reo, White, Graham, and Peerless. For tractors, including Fordson, Gray, Holt, Cadillac, Caterpillar, Monarch and Avery, the charges range from $1.20 to $4.00 an hour.

The trucks include the Denby, Ford, F. W. D., Heavy Aviation, Hurlburt, International, Light Aviation, Mack, Coleman, Nash, Packard, Pierce Arrow, White, Chevrolet, Reo, Yellow Knight, G. M. C., Walter, Autocar, Super and a Fox loader. These range in rental price from $1.30 to $3.50 for ordinary work, and $3.50 to

$5.50 for snow work and $5.50 for the Fox snow loader.

The oil distributors, Mack and Packard, rent for $4.50 and $4.00 an hour respectively. The crushers, Acme, Champion, Climax, New Holland, Reliance and Wheeling, rent some at 80cts an hour and some at 40cts. Derricks rent at 30c for heavy and 10c for light. Air compressors, Ingersoll-Rand, Novo, Schramm, Domestic, Chicago and Kleinhaus, rent at 90c an hour. Browning, Ohio, Osgood, Thew, Universal, and Byers cranes are rented at from $2.40 to $4.00 an hour.

Farquhar, Frick, Russell and Huber traction engines are rented at $1.20 and $1.40 an hour. A cement gun at $5.00 an hour. American hoists at $1.40 and $1.50 an hour. Lakewood finishing machine at $1.30 an hour. Fairbanks, Jaeger, Koehring, Rex, Voss and Wonder mixers rent at 80c an hour without operator or $1.30 with operator, except two which rent at $1.50 and $2.50 an hour respectively.

Champion, Zenith, Berger, Burch, Barber-Greene and Northern belt conveyers rent at 60c an hour; and two makes of bucket conveyers at 90c and $1.20 respectively. Rogers and Kinney planers, 60c an hour. Austin, Buffalo, Huber, Kelly-Springfield, Monarch, Galion and Acme rollers are rented, some at $1.20 an hour others at $1.60 without or $1.80 with scarifier. Erie, Osgood and Insley Shovels are rented at $2.50 for one and $4.00 for the others. Acme, Adams, Austin, Baker, Champion, Climax, Galion, Russell, Standard, Western, Wheeling, Hadfield-Penfield and Avery road machines are rented at 20 and 30c an hour. Baker, Champion, Moul, La Plante-Choate, Seabrook-Sargent, Snow King, Russell and Harrisburg snow plows and one constructed by the department, rent at from 80c to $2.00 an hour. Austin, Buffalo and Lakewood scarifiers at 30c and 40c. Acme, Etnyre, Studebaker and Hvass sprinklers at 20c an hour. Hvass and Good Roads chip distributors at 30c. Burch, Bangert, Galion, stone distributors and one of department construction are rented at 30c. Lakewood subgrader at 20c. Hvass, Studebaker, and Acme sweepers at 30c. Studebaker, Troy-Ajax, Watson and Acme wagons at 10c. Mowing machines at 20c. Snow fence at 5c per foot. A rental of $365 a year is charged for each superintendent's office.

ANNUAL EQUIPMENT EXPENSE AND OPERATION RECORD

An annual "equipment expense and operation record" is made out for each machine, on sheets, which give equipment number, make, kind, capacity or size, and date purchased. There are vertical columns for the code number; the previous expense, with the years in which it was incurred; the total for each of the four quarters, and for the current year and the total to date. The items listed include fuel and gasoline, lubricants, operators, transferring for repairs, air compressor, batteries, cleaning and painting, transferring for storage, etc.; total operation and repair cost, overhead ten percent, depreciation, insurance, storage, license, interest (5 percent inventory value), the total cost, and the cost per hour. Also miles per gallon of gas and miles per pint of oil. Special tabulations also are made for special appliances such as stone crushers, hauling, or snow removal, giving the fuel used, work done and rental charges.

A monthly report sheet is filled out for each piece of department-owned equipment, to be used for charging equipment to the authorization, section, and operation on which it is working. On this are entered, for each day of the week, the number of hours working on each section or route, also the hours operating and miles run on miscellaneous hauling or snow removal, the ton-miles hauled each day, the kind of material hauled, the gallons of gasoline and the pints of oil used. If equipment is not operating on a given day, the reason must be stated. In addition to the equipment number, this report gives the make of each tire, the tire number, the previous mileage, and the total mileage up to the date of the report.

A truck and automobile inspection report is filled out by the equipment inspector. At the top of the report are entered the make and kind of equipment, department number, assigned to driver, engine number, located on route No....., county, date inspected, condition of license plates speedometer reading. Also whether the vehicle has apparently been properly, oiled and greased and whether extra oil and grease are carried with it. Ninety items are listed on this report, such as radiator hose, radiator guard, front axle, steering knuckles, tie-rods, motor bearings, water pump, fan belt, etc.

Camp and Plant Sites for Paving Contractors

A highway contractor must usually provide at his own expense space for building, storage yards, cement sheds, repair shops, or any of the other accessories necessary for the performance of his work. There is seldom room for these on the public highway but such room must be arranged for on farms or other private property adjoining.

A. H. Hunter, engineer, Illinois Association of Highway & Municipal Contractors, says that he recently heard of a contractor whose investment for plant facilities exceeded 5,000, and of another who purchased an entire farm, possibly finding this cheaper than to pay rent for sufficient acreage. In his experience, an estimate of $200 for rental of property required for a plant set-up would be the least that should be figured on.

There will also frequently be damages to pay because of the fact that, with 60 to 80 men at work, some are at times trespassing on private property and accidents and contingencies arise where it will be necessary to pay claims of owners for damages done.

Concerning sidings, Mr. Hunter says that only in rare instances are adequate sidings available. "Do not be tempted to utilize one that does not fully meet your needs. The resulting loss from inconvenience and reduced production will be more expensive than if you had provided proper trackage at your own expense." The length of siding required will be slightly more than twice the length of cars necessary to supply the material for a maximum day's run. His experience during the several years has been that the investment for siding required for a highway job is in the vicinity of $2,500 to $3,000; but with allowance for material rented from railways which, if properly returned, would result in some saving, the net cost averaged about $1,500.

He believes that few contractors keep any separate account of the cost of delivering equipment and supplies to the unloading point. However, taking the equipment to a given point, unloading it, getting it into position for work and returning it, is an expense rather difficult to estimate but in his judgement should be estimated at about $1,600.

North Carolina Highway Work

The North Carolina State Highway Commission reports that 1,205.85 miles of new roads were built last year, and that the total expenditures for road and bridge construction amounted to $22,598,852.94.

The report showed that the following number of miles of new roads were completed during 1927:

227.50 miles of graded road, which was let to the contractors for an average of $8,000 per mile. This figure, which includes the cost of drainage and the building of small structures, does not include engineering and contingency costs.

221.99 miles of sand clay, or gravel surfacing at $1,250 per mile, including drainage costs and expenditures for small structures.

395.51 miles of concrete surfacing at an average cost of $22,000 per mile. This cost does not include engineering and contingency costs, however.

67.33 miles sand asphalt surfacing road at an average cost of $15,500 per mile.

243.32 miles of road treated with road oil at $3,500 per mile.

The engineering and contingency cost will average about ten per cent of the cost of each mile of road bulit.

Of the $22,598,852.94 expended, $1,373,828.15 was for new bridges.

Nail Picker in New Mexico

The State Highway Department of New Mexico has been using a "nail picker" (the name given locally to the electro-magnetic metal sweeper which is used for removing pieces of iron from the surfaces of the highways) and its report for May states that the sweeper has completed its work of removing scrap metal from the highways of District 2 in the southeastern part of the state. The machine covered 1213 miles, including the principal travelled roads in the district. Thirty-eight miles were covered with four trips, 370 miles required three trips, and 805 miles were covered with two trips. During the month 10,310 pounds of scrap metal was picked up. This included nails, screws, bolts, tacks, pieces of springs, wire, tin, etc. The sweeper covered an average distance of 24½ miles a day and removed an average of 8½ pounds from each mile of highway. Three more metal sweepers have been ordered by the department.

County Road Maintenance Methods and Equipment

Kinds and amounts of equipment used by counties. Typical equipment of a gang and a patrol in the various states, number of men in each. More than one hundred thousand pieces of equipment used by counties.

In connection with the general information given in this article we suggest that the reader turn to page 187 of the May number of Public Works and note the details of the methods of maintenance employed in Minnesota, where 7,000 miles of state and 12,000 miles of county roads are under maintenance.

The data from which this article was prepared contain much detail information of which, because of the limitations of space, only a short summary could be published.

During April, 1928, PUBLIC WORKS surveyed maintenance and equipment methods in a large number of representative counties throughout the country. In making this survey, nearly all counties having a population less than 10,000 were omitted from consideration, and blanks were sent to the larger 2,371 counties. Fairly definite and accurate returns were received from about 30 per cent. of these. The figures given in this article are based upon all returns received.

As compared to a few years ago, the amount of maintenance and construction equipment in use is surprising. Practically all patrol maintenance is now mechanical; gang maintenance equipment is quite standard, as will be seen from the material hereafter presented, generally including a tractor, a truck, graders, and frequently other equipment.

The average county owns and uses 8 motor trucks; of the approximately 16,000 trucks in county road service, 28.4 per cent. are 1 ton or under; 22.5 per cent. are 1½ to 2-ton; 33.1 per cent. are 2½ to 3-ton; 6 per cent. are 3½ to 4-ton; and 10 per cent. are over 4-ton.

Based on the estimate that 2,000 counties are actively engaged in road work, and on a typical cross-section of counties in all states and all parts of the country, we estimate that the following total amount of equipment is in use:

Tractors	6,590
Road drags	38,230
Horse-drawn graders	17,470
Power graders and maintainers	10,890
Scrapers	16,880
Wheel scrapers	5,800
Road rollers	1,300
Stone crushers	960
Gravel screening plants	270
Power rock drill outfits	500
Portable air compressors	310
Concrete mixers	1,310
Asphalt heaters & kettles	690
Diaphragm pumps	370
Gasoline-driven pumps	640

Methods of road maintenance by states follow. In some New England states, the counties do no work, all construction and maintenance being done either by the state or by towns, townships, boroughs or other small units. In some of the thinly settled Western states, maintenance is carried on by the state highway departments because there are few, if any, improved roads for which counties are responsible.

ROAD MAINTENANCE DATA

Alabama—Patrol maintenance on sand-clay and gravel roads is quite common practice. Gang maintenance is less common, but is employed by some counties. Tallapoosa county, for instance, has ten gangs of 6 men each, which employ two 7-mule and eight tractor outfits, of which six are "Sixty's" and two are "Thirty's."

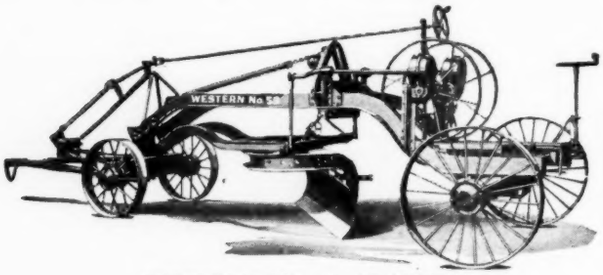
Arkansas—Patrol maintenance is employed by some counties, each man caring for 20 to 30 miles of dirt and gravel roads. Hot Spring county also employs two gangs of 2 men each for general gravel maintenance, each gang having a crawler tractor and grader.

California—Most of the California counties employ gang maintenance, the number of gangs varying

in the different counties. From 3 to 10 men make up the usual gang, the number depending upon the season. Gang equipment normally includes graders, tractors, and trucks, and in some cases such special equipment as steam shovels and tar kettles.

Colorado—Lake county uses gang maintenance on 46.5 miles of gravel, employing two gangs of 9 men each. The equipment of each gang includes one 10-ton tractor, a heavy grader, three 1½-ton trucks and smaller equipment.

Florida—Nearly all the more prosperous counties employ gang maintenance over all or most of their improved mileage. The various counties report from one to twelve gangs of 3 to 15 men, averaging about 10. Regular equipment for each gang normally includes one or more tractors and graders, hand tools, drags, and wheelers, while some outfits also have road rollers, tar patching outfits, and draglines.

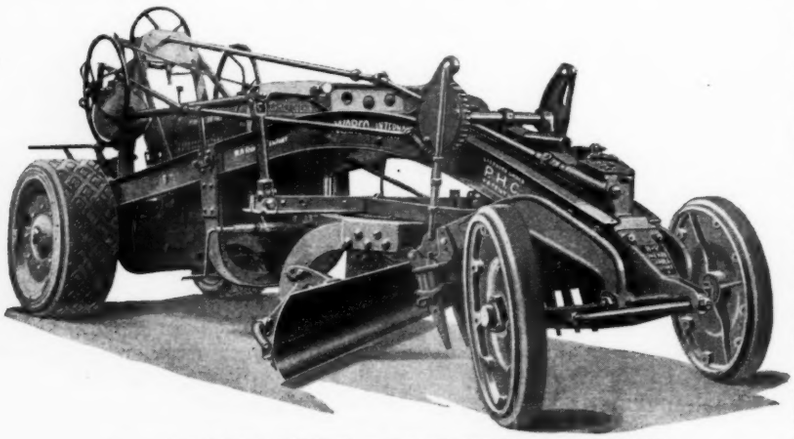


WESTERN NO. 55 GRADER.

Georgia—There appears to be no uniform practice in regard to maintenance methods in Georgia. In some counties convicts are employed on roads. Machinery reported in use by such gangs include graders, tractors, both 5 and 10-ton trucks, and small tools.

Idaho—The general practice is to employ gang maintenance on improved roads, the gangs containing from 2 to 7 men. The equipment commonly used includes trucks, tractors, graders, drags and small tools; other equipment reported includes 5 and 10-ton caterpillars, Best tractors, and tractor-grader combinations.

Illinois—Patrol maintenance is employed by most

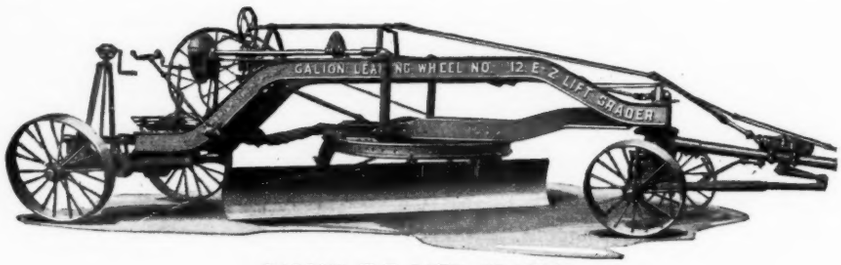


W. A. RIDDELL MODEL F REAR CONTROL GRADER.

"CATERPILLAR" 60, WITH BLADE GRADER ON PLYMOUTH ROAD, WAYNE COUNTY, MICHIGAN.

of the counties on dirt, gravel and macadam roads. The amount maintained per man as a rule varies from 2 to 8 miles where horses are used, and is as much as 30 miles where motor maintenance equipment is employed. Gang maintenance is used most generally on higher class surfaces, but in some cases on dirt and gravel also. The amount assigned to a gang averages around 30 miles, but varies from 15 to 50 miles. Gang equipment generally includes tractors, graders, maintainers, drags, trucks, and small tools; also, in some cases, asphalt heaters, crushers and other equipment. Gangs usually comprise from 2 to 5 men.

Indiana—Most Indiana counties employ the patrol system, with the patrolman covering about 30 miles of road, mainly dirt and gravel. Some counties use

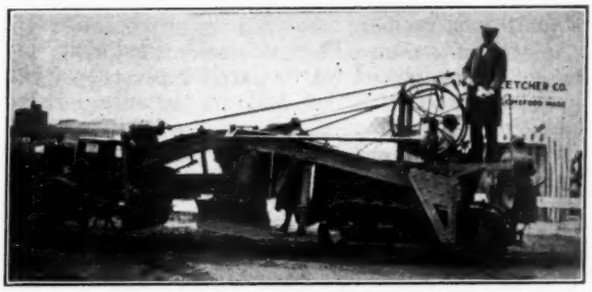


GALION E-Z LIFT GRADER.

the gang system, the gangs reported varying in size from 2 to 20 men. Gang equipment quite generally includes tractors, trucks, drags, graders, cement mixers, tar pots and small tools.

Iowa—Of 48 counties reporting from Iowa, only one does not employ the patrol system of maintenance, while 16 do not employ the gang system. Patrol maintenance is employed on dirt and gravel roads; the length assigned to each patrolman averaged around 9 miles, being greater where motor equipment was used and less with animals. Maintenance gangs are small, averaging about three men; but equipment is quite complete, including tractors, trucks, blade graders, mowers, tar kettles, wheelers, slips, small tools, and, in some cases, snow removal equipment.

Kansas—All of the 41 Kansas counties reporting employ gang maintenance, principally on earth and gavel, but in some cases also



GOOD ROADS MOTOR GRADER.

on hard-surfaced roads. The length assigned to a patrol averages about 8 miles, varying somewhat, but not greatly, above and below this figure. About half of the counties employ gang maintenance also, the gangs averaging slightly under 5 men each, and maintaining about 30 miles per gang. Equipment generally used includes light and heavy tractors, trucks, graders, tar kettles, mowers, and concrete mixers, as well as small tools.

Kentucky—Both gang and patrol maintenance are employed in Kentucky, but practice is not very uniform. In some counties only small tools are used, while in others fairly complete equipment is provided.

Louisiana—Conditions in Louisiana are much the same as in Kentucky, but some counties are carrying on good work. Rapides Parish, for instance, maintains eight gangs of about 6 men each, and county equipment includes 6 motor trucks, 4 tractors, 11 power graders, 10 scrapers, and other tools and equipment.

Maryland—The more populous counties in Maryland have excellent highway organizations, while rural counties do less work. Both gang and patrol maintenance are employed: on the latter, each man cares for 4 or 5 miles of road. Gangs usually average about 5 men. The equipment of Baltimore county, which employs 45 gangs, includes 47 motor trucks, 12 tractors, 17 snow plows, 18 drags, 45 graders and maintainers, 17 asphalt kettles, 15 steam rollers, 4 gas rollers, and 6 concrete mixers.

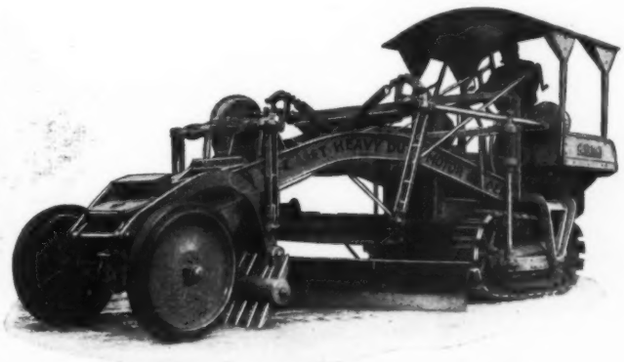
Michigan—Both patrol and gang maintenance are employed by many Michigan counties. Lengths assigned to patrolmen vary widely, according to local conditions. Gangs are usually equipped with trucks, graders, and, in some cases, tar kettles and other special equipment.

Minnesota—Practice in Minnesota appears to be good and exhibits considerable uniformity throughout the state. Practically every one of the 56 counties reporting employs the patrol system of maintenance, and a number of them use the gang system as well. On earth and gravel roads, the patrolmen quite uniformly handle 8 or 9 miles of road, although in some places less and in some more. Most of the work is handled by power-equipment machinery of the one-man type. Gang equipment normally consists of trucks and graders, and some special equipment. In general, the work appears to be well planned and carried out.

Missouri—Only a few counties report any organized and continuous maintenance work. Where gangs are used, tractors and graders form the basis of their equipment in nearly every county.

Montana—Nearly all of the more populous Montana counties employ the patrol system, and a number also employ from one to five gangs. Phillips county states that the patrol system will be adopted this year. The work is well organized. Gangs consist of from 2 to 10 men, usually 4 or 5. Tractors, large bladers, trucks, and similar equipment are usually provided each gang. Judith Basin county owns a truck equipped with a Willet spring scraper, which it uses on gravel maintenance.

Nebraska—A number of the counties report that they use the patrol system on dirt and gravel roads. Patrolmen are generally equipped with power graders or maintainers and cover about 30 miles each. The gang system is less used; where it is in force, the equipment is quite generally a tractor or truck and graders.



GALION HEAVY-DUTY MOTOR GRADER.

New Jersey—Conditions vary widely in New Jersey; some of the very populous and wealthy counties maintain a most elaborate and complete maintenance system, with eight or ten gangs of 6 to 20 men each, fully equipped with tractors, trucks, mixers, rollers, and other tools.

New Mexico—Because of the great distances and the scattered population, maintenance work in New Mexico is not on a complete or uniform basis. In some counties it is practically limited to the work

RUSSELL MOTOR PATROL.

MONARCH "50" TRACTOR.

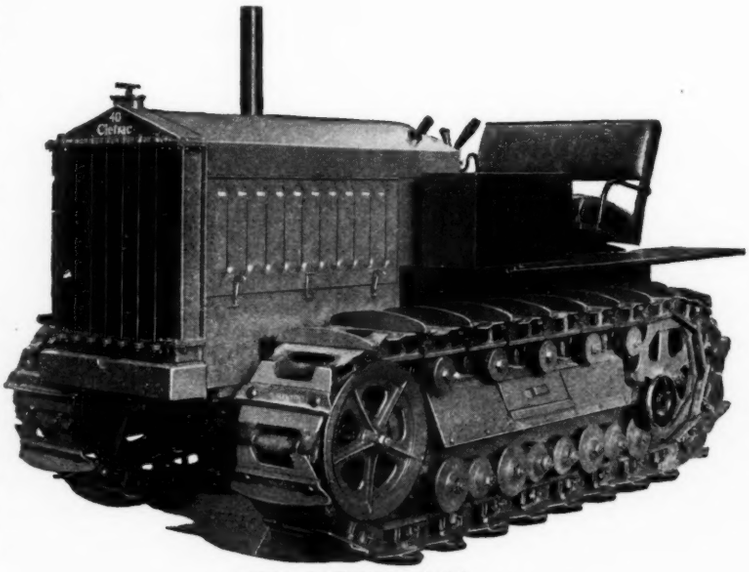
done by the state on state routes; but some counties have a well established organization. Colfax county has two gangs of 4 men each, equipped with crawlers and Galion crawler maintainers, and also does patrol maintenance on about 1,800 miles of dirt road, but states this is "not properly" maintained. Rio Arriba county has four gangs of about 2 men each, equipped with tractor and blade.

New York—In New York, gang maintenance is almost exclusively and universally employed, though there are some counties where no work is done by local authorities. In Westchester county, for instance, practically all maintenance is done by the state; but most counties have from one to five gangs, who work mainly on the gravel, macadam, bituminous macadam and concrete roads. A truck, a small concrete mixer, and small tools form the usual equipment for the gangs, which average from 8 to 10 men each.

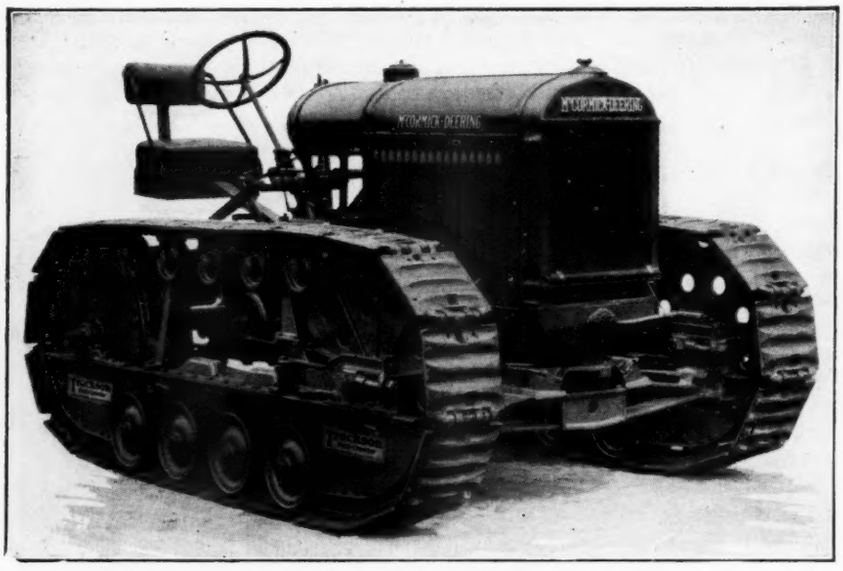
North Carolina—The Coastal, Piedmont and mountain sections of North Carolina present varying problems in construction and maintenance. Patrol maintenance is employed largely on top-soil and sand-clay roads. In some counties each man maintains as much as 150 miles, though the average is much lower than this. In Nash county, 5 patrolmen care for 145 miles of sand-clay and gravel; in Pitt county, 120 miles is assigned to each man; in Robeson county, 150 miles. Gang maintenance also is employed widely. Beaufort county maintains seven gangs, each equipped with an International 15-30 tractor, graders, drags, and 1-ton trucks. Johnston county has five gangs of 12 men each, equipped with 2-ton and 5-ton tractors, 3-ton trucks, and smaller tools. Mecklenburg county has 23 gangs of about 6 men each.

North Dakota—Where the patrol system is used, most North Dakota counties assign about 8 miles of road to each patrolmen. Fewer counties use the gang system; where used, gangs usually comprise 3 or 4 men, and equipment consists of crawler tractors, blade graders, maintainers and motor trucks

Ohio—The majority of the 23 Ohio counties reporting their maintenance methods use gang maintenance, though a number report patrol work on gravel and stone roads. Gangs are variable in size, but usually comprise less than 10 men. Equipment includes, in various counties, tractors, mixers, trucks, heaters, rollers, blade graders and drags. One county with five gangs of 5 men each reports different equipment for each gang.



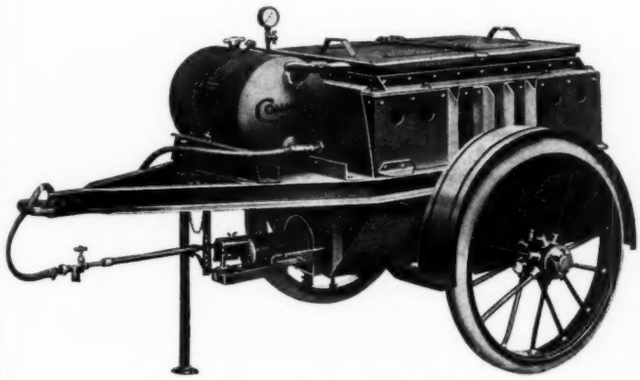
NEW CLETRAC "40."



TRACKSON-McCORMICK-DEERING CRAWLER.

Oregon—Maintenance work in Oregon appears well-organized, but is not uniform. Both patrol and gang maintenance methods are used. Usual equipment includes tractors, trucks, graders, and drags, including one-man graders. In some counties, work is done under the old road district plan.

South Carolina—Most counties employ both patrol and gang maintenance. Gangs usually consist of 2 to 4 men, but sometimes more. Equipment generally includes tractors, trucks, and road machines.



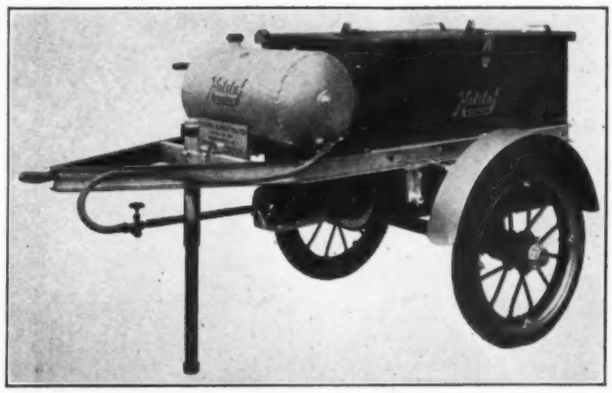
CONNERY TAR AND ASPHALT HEATER.

LITTLEFORD HEATER.

South Dakota—All of the 18 counties that reported employ patrol method of maintenance, the average patrol covering about 10 miles of earth or gravel roads. Slightly less than half the counties use the gang method also, the gangs usually consisting of 3 or 4 men; equipment usually furnished gangs includes tractors, graders, drags and patrol graders. The counties have little hard-surface mileage.

Tennessee—Methods of rural road maintenance in Tennessee are well described in an article by F. B. Wilkes, which appeared in the May issue of PUBLIC WORKS. This article illustrates well the rapid change in maintenance methods during the past few years, and the amount of modern equipment now used by counties.

Texas—Conditions vary widely; some counties maintain elaborate organizations, while others do practically no maintenance work. Some still use teams, but they are in the minority. El Paso county and the El Paso-Hudspeth road district have ten gangs of 11 men each, and the equipment includes 14 motor trucks, 5 tractors, 10 graders and maintainers, 10 scrapers, 2 concrete mixers and much other equipment. Hays, Atacosa and Camp counties have considerable equipment. Cameron county equips its gangs with trucks, tractors, graders, and asphalt repair outfits.



"HOTSTUFF" TRAILER ASPHALT HEATER.

Washington—Washington counties use both patrol and gang maintenance. Patrolmen ordinarily are assigned to cover about 25 miles of road. Gangs average 4 or 5 men each, and equipment includes trucks and tractors, graders and small tools. Clallam county operates 25 trucks and a number of other counties have fleets of 12 or more.

West Virginia—Returns from 11 important counties show maintenance work quite well organized. The patrol method is not widely used; where it is used, each man covers 5 or 6 miles. Gangs consist of 5 to 20 men and are well equipped with tractors, trucks, one-man graders, plows, slip scrapers, tar kettles and, in some cases, air compressors.

Wisconsin—All but one of the 27 Wisconsin counties reporting maintenance methods employ the patrol system, and the average length assigned to each patrolman is about 8 miles. About two-thirds of the counties also employ the gang system. Gangs vary

BUFFALO-SPRINGFIELD ROAD ROLLER.

MACK TRUCK DUMPING ROAD SURFACING MATERIAL.

in size, from 3 men up, averaging about 8 men; usual equipment includes tractors, trucks, graders, patrols, and smaller tools. Some counties also maintain construction gangs, which have graders, slips, wheelers, drills, wagons and other construction equipment.

Per Capita Water Mains

In the report for 1927 of the Division of Water of Columbus, Ohio, information is given concerning the water system for the past forty-seven years. Among the items is the amount of cast-iron pipe per capita, given in both lineal feet and cubic feet capacity.

In 1927 there were 9.0 lineal feet of cast-iron pipe per capita and 4.94 cubic feet of pipe capacity per capita. This was an incease from 7.9 and 4.31 respectively in 1920 and from 7.6 and 2.63 respectively in 1900. In 1880, the first year shown in the table, the linear feet of cast-iron pipe per capita was 4.2 and the cubic feet capacity was 1.12. This shows that the linear feet per capita has more than doubled during the forty-seven years, while the capacity has increased more than four times. The greater percentage increase in capacity than in length of pipe is of course indicative of the increased size of pipe laid during the last twenty-five years.

Financing Sewage Treatment Operation in Ohio*

Most municipalities neglect operation of sewage treatment works through lack of funds. Operation of Ohio's sewer rental law as a remedy.

By F. H. Waring†

Whether a sewage treatment plant is a success or a failure depends in greatest measure upon whether or not the plant is operated in skilled fashion. The general observation is made that it is not nearly so important what type of works is installed or how elaborate the equipment, as it is what effort is being made to operate the works intelligently.

Provision for proper operation of the sewage works by a municipality usually involves two main considerations: personnel and finance. These items are closely related, because, without proper financial provisions technical supervision and skilled operation are impossible. In some states (Pennsylvania and Ohio) municipalities are confined within certain statutory limits regarding expenditures for construction of works and for ordinary operating funds. In the majority of states these financial restrictions are not statutory. In all states, however, there exists the need of convincing local authorities of the advisability and necessity of providing funds for adequate operation of sewage treatment works.

The degree of financial provision for operation, then, usually dictates the degree to which the sewage treatment is scientifically operated. In proportion to the budget provisions the personnel will vary all the way from regularly employed technically trained and experienced men to the very non-technical or laborer class of operator, or even to no regularly employed full time operator.

Ohio Sewer Rental Law.—In 1923 a law was passed with particular reference to the financing of the operation of the sewage treatment works. This statute is known locally as the sewer rental law. The purpose of this law is to permit municipalities to assess and collect charges for the use of sewers and to provide for the proper maintenance, operation and control of sewerage systems and sewage disposal works. The law is intended to place the sewerage department of the municipality upon much the same basis as the water department is placed; in other words, the department will be operated as a utility and placed upon a self-supporting basis by equitable charges for sewerage and sewage disposal service.

Past Experiences in Sewage Works Operation and Control.—Ohio has about 75 sewage treatment plants serving municipalities, these plants differing widely in size and type, including devices of almost every description. In past years efforts to obtain satisfactory operation of sewage treatment works in Ohio have not been entirely successful; probably less than 10 per cent. of the plants have been operated under technical supervision and probably less than 20 per cent. have been giving satisfactory service to protect the streams from nuisance and undue pollution conditions.

*Paper before Ohio Conference on Sewage Treatment.
†Chief Engineer, Ohio Department of Health.

A survey of the stream pollution conditions within the state was begun about five or six years ago and one of the first important conclusions reached was the reason for failure of sewage treatment works. It was found that the municipalities neglected the operation of the works largely on account of inability to finance their operation out of current revenues. Ohio laws limit municipalities very markedly in the amount of money that may be raised by taxation methods, with the result that all activities have been cramped very materially in the last decade. Various efforts have been made to enact new laws on the taxation question in order that the municipalities might have more money to spend for improvements and for operation of the various departmental activities of the corporation. It was invariably the rule that sewerage service and sewage treatment and disposal items were the last to be taken care of. This remained true even though the cities might be forced to pay damages for conditions created by the neglect of the sewage treatment works, because damages were a preferred charge against the municipality and did not come within the ordinary bond and tax limitations.

During the past few years the Ohio Department of Health has adopted the policy of refusing to approve plans for new sewage treatment works unless the department could be reasonably well assured that sufficient funds would be provided for the correct maintenance and operation of such works. It is somewhat surprising but nevertheless true that municipalities wanted to build plants without knowing exactly where the funds would be procured to operate them. In large measure the reason was to hold off damage claims and embarrassing injunction suits.

It was observed that an order of the department regarding the correction of improper operation might be nullified if the municipality did not have sufficient funds to operate under the order. It was for this reason that the department requested the passage of the sewer rental law enacted in 1923.

Experiences With the Sewer Rental Law.—Since the statutes have been amended to provide for special revenues for sewerage departments, several municipalities have passed ordinances fixing charges for sewer service which will make possible the proper financing of the sewage treatment works. The revenue required in the case of the ordinary village or small city may easily be secured from a flat rate charge and it appears that about $4.00 to $5.00 per year per house connection will bring in enough money to take care of the operation charges. An example of such an ordinance is that of the city of Delaware (population 8,500). Some municipalities have determined upon a graduated scale of charges based upon the water consumption as a measure of sewage flow. An example of an ordinance of such a nature is the one for the village of Oxford (population 2,100). In those instances where industries may be provided with private water supplies, estimates of sanitary and industrial sewage may be made. An example of such an ordinance is that which is being considered by the city of Canton (population 87,000). Five municipalities have had in effect such ordinances for a year or more, and two have recently adopted such ordinances. Fifteen municipalities are contemplating sewer rental ordinances or have taken the preliminary steps to place the ordinances on the local statute books. The seven municipalities now with ordinances are: Andover (921), Bellefontaine (9,336), Brewster (928), Delaware (8,576), East Palestine (5,750), Euclid (3,363), Oxford (2,146)).* The populations of these seven communities range from 921 to 9,336. The fifteen contemplating sewer rental ordinances are Akron (208,435), Canton (87,091), Centerburg (775), Chardon* (1,566), Columbus (237,031), Cleveland (796,841), Dayton* (152,559), Fostoria (9,987), Galion (7,374), Granville* (1,440), Lebanon (3,396), Leetonia (2,688), Marysville (3,635), Sebring (3,541), and Xenian (9,110). The populations represented by these fifteen communities range from 775 to 796,841. In the foregoing list of fifteen municipalities now contemplating rental ordiances, six represent municipalities where new plants are under construction or just completed; two where new plants are being proposed to take the place of existing real old ones; and the remaining seven have plants that have been constructed within the past few years.

Attitude of Municipalities Regarding Technical Operation of the Plants.—It is pleasing to note that, in the new works now being projected in the state where the matter of skilled operation has been broached to the municipal authorities as a condition upon the construction of the works, the municipality is accepting this important item without question. It seems that most of the municipalities are beginning to realize the necessity for skilled operation and supervision of the plant, which can only be obtained by properly educated men.

Comparatively little difficulty is being experienced in convincing large cities of the advisability of providing technical talent to direct the operation of the sewage treatment works. Those in authority at these large cities readily understand the wisdom of protecting a huge investment; and they realize that if the city's interests downstream from the treatment plant are to be protected properly, scientific management and a technical record of the operation are imperative. The most recent example of this attitude is the city of Canton, which has made provision for a salary of $4,000 for a high grade, technically trained sewage treatment superintendent.

Small cities are not so easily convinced that provision should be made for technical control of the operation. The salary to be paid for the technical talent seems large in proportion to what is paid the mayor, director of public service or other city officers. Unless the duties of other positions such as water purification management, superintendent of water works, city engineer or the like are added, few small cities will voluntarily pay the salary required. Two exceptions are to be noted: (1) In the case where the city is constantly being sued by property owners below the works and forced to defend itself against damage claims; (2) in the case where previous neglect or improper operation resulted in ruin of the works, and entire replacement has become necessary within a comparatively short time.

There are some special examples of a keen incen-

*Sewer rental ordinances for the municipalities of Chardon, Dayton and Granville were also in effect in January, 1928.

tive to operate the sewage treatment works in scientific manner. For instance, the city of Portsmouth, Ohio, which has a sewage treatment plant serving a suburban portion of the city and located 1½ miles upstream on Ohio river above the city's water works intake; and the city of Cleveland, which takes its water supply far out from the shore of Lake Erie and maintains bathing beaches along the shore, but into which waters not far from the shore are discharged the sewage effluents.

Generally speaking, however, the incentive for high grade talent in the operation of sewage treatment plants is lacking naturally. The proper municipal attitude can be cultivated, though. A little effort with the city officials may keep alive the very interest which caused the plant to be constructed. It is even sometimes a good plan to hold back a community in its desire to build such works until a proper appreciation is held for the necessity of technical control of operation and due provision is made therefor. One thing is certain; wherever technical operation is once provided, constant publicity by the plant operator is essential or the financial support making possible such operation may be withdrawn. With careful and studied effort on the part of the operator, a proper sentiment and support can be developed.

The Ohio Department of Health is making concentrated efforts upon both large and small municipalities to provide better skilled operation and supervision. It is our policy to see that all new works make provision for proper supervision of operation and to encourage such supervision of existing works as fast as possible. Recent accomplishments in this direction are the arrangements made by the small city of Xenia (9,110) to have part-time technical supervision by the chemist in charge of the Columbus sewage treatment works; and by the city of Delaware (8,576), which has contracted jointly with the city of Marion (27,891) in the employment of a trained technical operator.

In the case of Xenia, the part-time supervision costs about $600 per year or $50 per month; while in the case of Delaware, the joint contract arrangement costs Delaware $900 per year or $75 per month. Xenia is about 50 miles from Columbus; Delaware, however, is only 20 miles from Marion. Therefore it follows naturally that Delaware is in position to profit more than Xenia in the foregoing arrangements and accordingly can afford to pay a trifle more for the increased time of skilled supervision.

The system which is being attempted is quite similar to that in vogue regarding the operation of water treatment plants in this state; namely, all cities of size, say over 15,000 people, make provision for a full-time daily skilled operator who is to reside in the community; and for smaller cities and villages part-time supervision by the trained man from the nearby larger city having proper technical supervision. In some instances it has been possible to combine the water treatment and sewage treatment technical work in the hands of one operator, although it is realized that this endeavor will be limited to the smaller municipalities where the time required at these works will be proportionately less. In some cases a supervisor has been obtained from a firm specializing in providing such service. The following municipalities now have provided for full time technical supervision of sewage treatment works: Alliance (21,603), Barnsville (4,865), Canton (87,091), Cleveland (796,841), Columbus (237,031), Marion (27,891), Medina (3,430), and Portsmouth (33,011). The following plants now have part-time technical supervision of the sewage treatment works: Delaware (8,756), Euclid (3,363), Leetonia (2,688), Lodi (1,240), Louisville (2,008), Oberlin (4,236), Sebring (3,541), and Xenia (9,110).* It is to be borne in mind that the effort of this department to obtain the high-grade skilled supervision and operation of the treatment works has only been carried on intensively for a little over a year. Some delay has been necessary until financial provisions could be prepared and adopted in the municipalities for the necessary revenues to carry on proper operation.

In conclusion, the writer wishes to offer the opinion that the failure for proper sewage works operation in the past has been due, at least in Ohio, to two main reasons: (1) There has been a lack of proper education on the part of the state toward the municipalities having the sewage works problem. This has been due largely to insufficient personnel within the department, although this has been remedied in Ohio within the last few years. (2) There has been a lack of appreciation on the part of municipalities toward properly financing the treatment and disposal of sewage; in addition there have existed peculiar financial limitations of municipalities in this state which have prevented them from providing sufficient funds, even where willingness was expressed.

OHIO SEWER RENTAL LAW

This law, which became effective July 30, 1923, authorizes the council of any city or village to establish just and equitable rates for charges of rent to be made for the use of the sewerage system; such charges to constitute a lien upon the property to be collected as any other taxes.

In a city, the director of public service is to manage the sewerage system and appoint the necessary officers for collecting rents. In the case of a village, the Board of Trustees of Public Affairs is to manage the system and collect the sewer rentals, appointing the necessary officers and agents. Such director or board of trustees may make such by-laws and regulations as may be deemed necessary for the safe, economical and efficient management and protection of the sewerage system and sewage disposal work; also for the construction and use of house connections.

The sewer rentals are to be kept as a separate fund to be known as the sewer fund, to be used for the payment of the cost of the maintenance, management, operation and repair of the sewerage system, sewage pumping, treatment and disposal work. Any surplus may be used for the enlargement or replacement of any part of the sewer system or for the payment of interest on the debts incurred by the construction of the system, but is not to be used for the extension of the system to serve unsewered areas or for any other purpose

*Part time technical supervision for Burton (592), Centerburg (775), Granville (1,440) and Salem (10,305), was also in effect in January, 1928.

whatsoever. A village which decides to establish rates or rentals for use of the sewerage system must at the same time establish a Board of Trustees of Public Affairs consisting of three members elected for a term of two years.

Delaware, Ohio, in its ordinance makes charges as follows: Dwellings and apartments: one family $4.00 per year, two families $7.50 with one connection or $8.00 with two connections; four families with two connections $15.00; additional, $4.00 per family. For hotels, $1.75 per year for each room with bath and $1.00 for each room without bath. For stores, restaurants, offices, and mercantile establishments, $4.00 per year each for private toilet, $8.00 for public; $4.00 per kitchen sink, $2.00 per slop sink. For factories and shops, $1.00 each for 10 persons or less, 90c each for between 10 and 25 persons, 80c for between 25 and 50, and 70c each for between 50 and 100, and 60c each for all over 100. For colleges, 75c per year for each registered student. Hospitals and sanitariums, $100 for one and $60.00 for another. These charges become due and payable in advance on the first day of January, April, July, and October.

Oxford, Ohio, charges 25c per thousand cubic feet of water consumed per quarter year, with a minimum charge of $1.25 per quarter for each sewer service connection from each premise to the sewer system. Rentals are payable quarterly.

Canton, Ohio, charges at the rate of 25c per thousand cubic feet for the first 20,000 cubic feet of water consumed upon the premises per quarter year, 20c per thousand cubic feet for amounts between 20,000 and 40,000, 15c for amounts in excess of 40,000; with a minimum payment per quarter of 75c.

Dayton charges $1.00 for the first three thousand cubic feet of water or fraction thereof used per quarter, and 30c for each thousand cubic feet between 3,000 and 10,000 per quarter, 25c for each thousand between 10,000 and 20,000, 20c for each thousand between 20,000 and 100,000, 15c for each thousand between 100,000 and 500,000 per quarter, and 10c for each thousand in excess of 500,000 per quarter, with a minimum charge of $1.00 per quarter. For use by buildings outside of the city limits, these rates are increased by approximately 25%.

Sewage Treatment Abroad[1]

Notes on some new ideas and practices observed by the author in 1927. Oil and grease removal; submerged contact aerators; activated sludge.

By Willem Rudolfs[2]

Sewage disposal methods in the Ruhr drainage district as carried out under the leadership of Dr. Karl Imhoff of the Ruhrverband, and Dr. H. Bach of the Emschergenossenschaft have been very productive of ideas, and have influenced American practice for a number of years. The methods employed in Holland under the direction of H. Kessener, director of the government institute for purification of waste waters, have by no means had such a direct influence in the United States. The reason probably is that most of his ideas, descriptions, and results have been published in Dutch and were practically inaccessible for the majority of our engineers. It is only lately that some of the results have been summarized in the English language. It is the intention in this article to describe briefly some of the newer ideas and methods used and proposed in the Ruhr district and in Holland.

OIL AND GREASE

The amount of oil and grease received at a sewage plant is constantly increasing. Aside from the question whether or not masses of oil impair the decomposition processes in digestion tanks, or affect the efficiency of aeration units, the material leaves grit chambers and sedimentation tanks unsightly or calls for extra and dirty work. (We expect before long to publish some experiments on the effect of waste automobile oil on the digestion processes.) The grease catchers installed by Dr. Imhoff at Essen-Rellinghausen and Kettwig, where he makes use of air to remove oil and grease, have considerable merit. In spite of the rather crude construction of the devices (figure 1), the amounts of grease and oil brought to the surface constitute a large proportion present in the waste.

At Essen-Rellinghausen the sewage is retained for only three minutes in the grease catcher, air is blown through the incoming sewage, causing the oil droplets to break and spread out on the surface. The oil then flows into the catchbasin and can be removed by skimming. An analysis of the material at the surface showed that it contained 34.8% dry matter, of which 5.75% is ash and 60% fats.

The grease remover at the Kettwig disposal plant receives wool washings and textile mill waste. The wool washings and mill waste are kept separate from the sewage until the wastes reach the plant. The total flow received at the plant is about 70 gallons per capita, of which only about 15 gallons per capita is due to domestic sewage. The rest comes from the wool washings and the textile mills. The waste is very dense and before it runs into the Imhoff tank it is pre-treated in the grease remover. The structural details do not differ from the one at Essen-Rellinghausen except that a wooden skimmer is used in the form of wooden paddles which pushes the grease into a trough. An analysis of the wool waste showed the following in p.p.m.:

	Inf.	Eff.
Total solids	1595	1488
Susp. solids	417	247
O_2 demand	728	722
B. O. D.	300	288

[1]Paper No. 66, Department of Sewage Disposal, New Jersey Agricultural Experiment Station, New Brunswick, N. J.
[2]Chief, Department of Sewage Disposal.

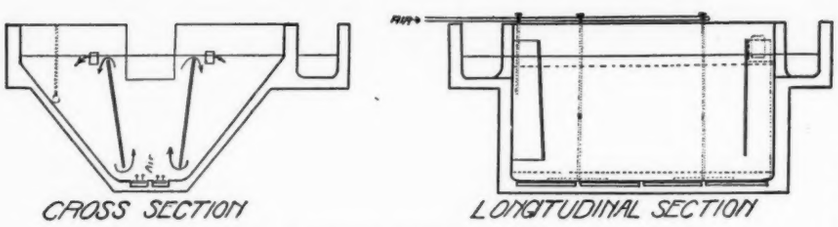


FIG. 1. GREASE TRAP INSTALLED BY DR. IMHOFF.

The percentage fat removal varies from 40 to 60%. More fat is removed in the Imhoff tank equipped with submerged contact aerators. (Tauchkörper.)

SUBMERGED CONTACT AERATORS (TAUCHKORPER)

The artificial aeration of trickling filters, studied in Moscow by Straganoff and called by him "aero-filters," marked the tendency to search for efficient but compact methods to replace the ordinary trickling filters. Bach[3] developed a Tauchkörper by filling a flat bottomed tank with slag, placing in the tank a series of baffles and applying compressed air from the bottom. The first example of this type of equipment was put in by the Emschergenossenschaft and is therefore called "Emscherfilter." Buswell in Illinois investigated rather extensively the use of "colloiders," and when Dr. Imhoff visited this experimental plant he saw at once the advantage of combining the two systems. Imhoff's newest submerged contact aerator consists of boxes filled with brushwood and swinging perforated pipes through which air is blown from below. Figure 2 shows the contact aerators in place at the Gevelsberg plant which was under construction last fall. There are nine plants under control of the Ruhrverband in which submerged contact aerators are an added feature. One or two are on trial at present in this country.

The results obtained with the contact aerators vary with the "flowing through periods." The flowing through periods might perhaps be called "time of contact." This contact time is at Essen-Rellinghausen only 5 minutes, whereas at the Hagen plant the contact time is about 30 minutes.

Results Obtained With Submerged Contact Aerators (in p.p.m.)

	Without contact aerator—					With contact aerator—					
	—Influent—		—Effluent—		%	—Influent—		—Effluent—		%	Contact
Place	Susp solids	B.O.D.	Susp. solids	B.O.D.	red B.O.D.	Susp. solids	B.O.D.	Susp. solids	B.O.D.	red B.O.D.	time minutes
Rellinghausen	...	...	...	...	..	151	133	60	133	0	5
Hagen	194	144	60	144	0	194	144	55	103	28	30
Langendreer	201	120	41	120	0	200	120	44	75	38	35
Iserlohn No. 1	481	273	207	273	0	481	273	207	187	32	30
Iserlohn No. II	481	273	207	273	0	481	273	207	167	38	30

Some of the results obtained are shown in table 1. The outstanding results are that (1) the suspended solids are not reduced by the contact aerator, (2) a short contact time has apparently no value; (3) with a contact time of 30 minutes a 30 to 35% reduction in biochemical oxygen demand is accomplished. In places where tank treatment only is practiced and the effluent from the tank puts a severe load upon the stream, submerged contact aerators might be of considerable value. The suspended solids clinging to the aerators are continuously removed by the strong stream of air, with the result that continuous unloading takes place, instead of periodic unloading as in trickling filter beds. This continuous unloading accounts for the fact that no reduction in suspended solids takes place and no *visible* improvement can be noticed; although the load to be handled by the stream is considerably lessened. This may be a drawback with laymen, since visible improvement is often an important factor with the city authorities who have to make the final decision for improvement.

[3]Bach, Wasser und Gas, Feb., 1926.

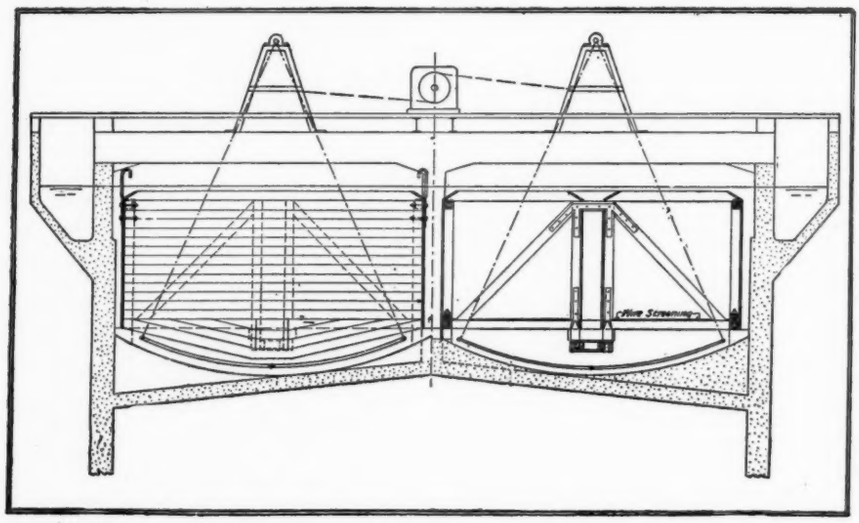


FIG. 2. SUBMERGED CONTACT AERATORS AT GEVELSBERG, NEWLY INSTALLED.

SLUDGE MIXING

Dr. Bach drew my attention to a new device used in the Emscher district to insure good mixing of sludge in separate sludge digestion tanks. It consists essen-

tially of a screw pump placed vertically in the middle of the tank which pumps ripe sludge from the bottom to the top of the tank every time fresh solids are admitted. This scheme of seeding is of interest in view of the claims made by Dr. Preuss[4] that it increases the effective sludge digestion capacity 100%. It is undoubtedly true that seeding of fresh solids is highly beneficial. Some stirring is also helpful, especially if a scum blanket is present, since it releases the gases, but too much stirring might be detrimental.

The greatest objection against continuous recirculation of the sludge in the tank is that partially digested material goes to the bottom and might be withdrawn together with the ripe sludge. When a new tank is started, and liming is practiced, circulation of the alkaline material at the bottom with the overlying acid material is greatly desired. Since such conditions usually occur only at the beginning of the operation of a new plant, circulation of sludge can be accomplished with the aid of a portable pump.

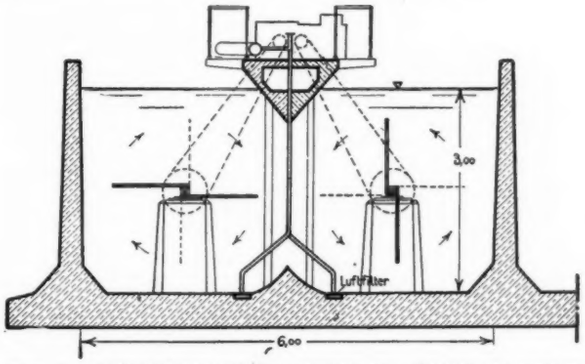


FIG. 3. AERATION TANK (IMHOFF) WITH PADDLES TURNING AGAINST THE AIR STREAM.
Air pipes (in center of tank) discharge air through distributors ("Luftfilter") in the bottom.

ACTIVATED SLUDGE

Production of activated sludge with greatly reduced air supplies as practiced at Essen-Rellinghausen is fully described by Imhoff, Fries and Sierp.[5] The sewage flow at the plant is about

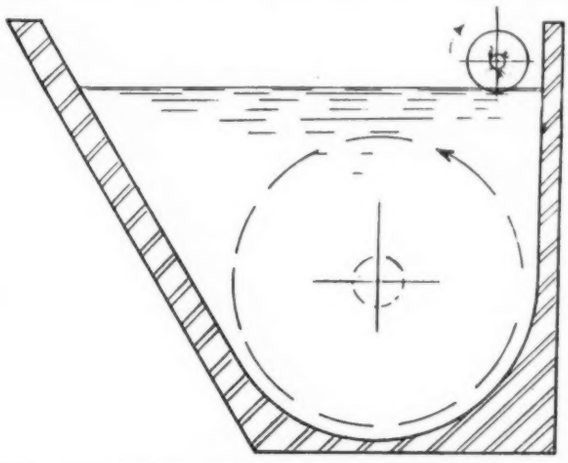


FIG. 5. NEWEST DESIGN (KESSENER) AERATION TANK FOR HILVERSUM.

160 gal. per capita, of which less than 20 gallons per capita is chargeable to domestic sewage. The remainder comes mainly from coal mine water.[6] The sewage is rather weak; average day sewage 180 p.p.m. total suspended solids, with comparatively high amounts of sulfates and chlorides. The total detention period throughout the plant is 4 hours, with 20 minutes in the Imhoff tanks, so that aeration time does not exceed more than 3½ hours (the volume of returned sludge being included in this detention period.) The air is supplied through porous plates placed at one side of the tank, and is a copy of Hurd's aeration practice at Indianapolis. Figure 3 shows a cross section of the aeration tank with the paddles used for keeping the sludge in suspension. The arrows indicate the direction of the movement of the paddles, which go against the air stream. The paddles revolve 7 times per minute, while the air supply is but 0.6 cu. ft. per cubic foot of sewage. Imhoff believes that turning the

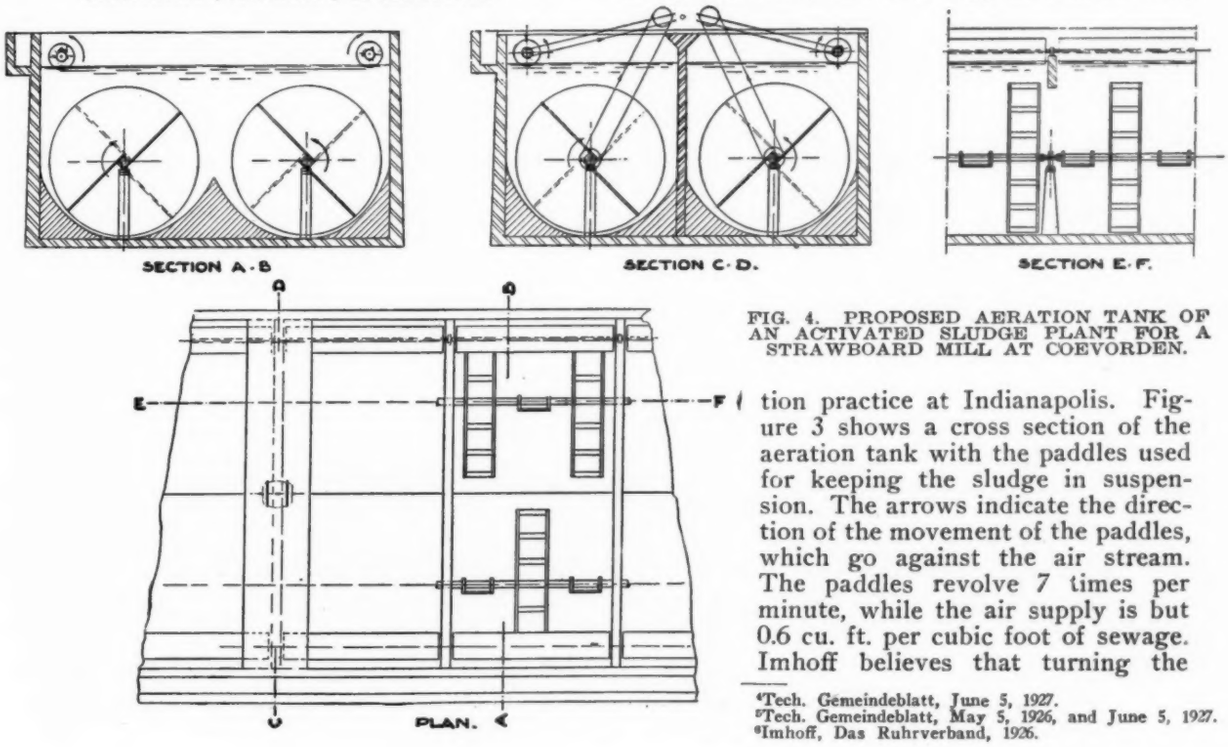


FIG. 4. PROPOSED AERATION TANK OF AN ACTIVATED SLUDGE PLANT FOR A STRAWBOARD MILL AT COEVORDEN.

[4]Tech. Gemeindeblatt, June 5, 1927.
[5]Tech. Gemeindeblatt, May 5, 1926, and June 5, 1927.
[6]Imhoff, Das Ruhrverband, 1926.

paddle wheels in the direction opposite to that of the air (sewage) flow has a great advantage for keeping the solids in suspension.

Kessener,[7] who uses street brushes for surface aeration and paddle wheels for keeping the solids in suspension, thinks that rotating the paddle wheels in the direction of the flow caused by the brushes is better. His paddle shaft makes only 3¾ rotations per minte as against 7 rotations with Imhoff's scheme. The bottoms of Kessener's tanks differ from those of Imhoff's. The ends of his paddle wheels nearly reach the bottom (see fig. 4), whereas the ends of Imhoff's paddle wheels are about 18 inches from the bottom. According to Kessener, these two small differences in construction are rather important for good results.

The Kessener aeration tanks under construction for the cities of Hilversum, Knocke and Breda are of a still different shape (figure 5). The surface of the tank is greatly enlarged with one steep sloping wall towards the round bottom. He increases the effective aeration surface while the power consumption on account of stirring is kept down.

[7]Public Works, April, 1928.

(To be continued)

Selling Schenectady Sludge

As stated in an article in our June issue, the city of Schenectady, N. Y., has succeeded in selling all the sludge produced by its sewage treatment plant. In a report recently made by the department it is stated that this is the fourth successive year that all the sludge has been sold as a fertilizer, and that scores of prospective buyers have been unable to obtain it and many others have not obtained the amount which they desired.

The businesslike marketing methods employed in Schenectady offers suggestions to other municipalities. Mr. Cohn, the plant superintendent, has given a series of lectures each year before farmers' meetings, has repeatedly obtained the aid of the County Farm Bureau and has also kept up a program of publicity through the local press. Efforts have been made to show the farmers how to use the sludge to best advantage. The Schenectady parks have been using it and reports indicate excellent results on grass and flower beds. This sludge has been delivered in test quantities to two golf courses and scores of bags have been given free to local householders for lawns and gardens. This distribution of sludge among the citizens has led to an awakening of interest in the treatment plant and favorable comment has resulted from the personal interest of persons who never before knew that the sewage works were in existence.

Activated Sludge Disposal Plants at Charlotte, N. C.

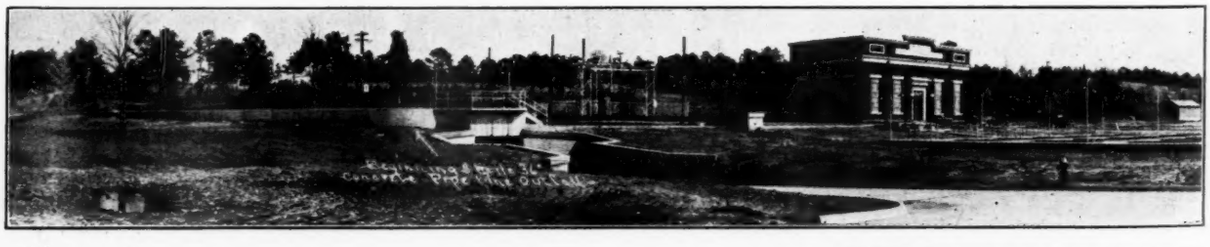
One dewaters sludge by means of vacuum filters, the other digests it in separate digestion tanks and utilizes resulting gas. Bottom-dump screen chambers. Sludge removal details in sedimentation tank.

By E. G. McConnell*

Charlotte, N. C., with a population of 80,000, is located on the rich Piedmont plateau which extends through the Carolinas. Being the center of excellent railway facilities, there has been built up a well rounded assortment of diversified industries. The city now has about 16,000 domestic and 200 industrial connections to the sanitary sewerage system. None of the industrial wastes now received for disposal appears to be very detrimental to plant operation, although dyeing and bleaching liquors from textile plants and excessive mineral oil drainage from garages cause some disturbance at times. There is very little storm drainage now entering the sanitary system.

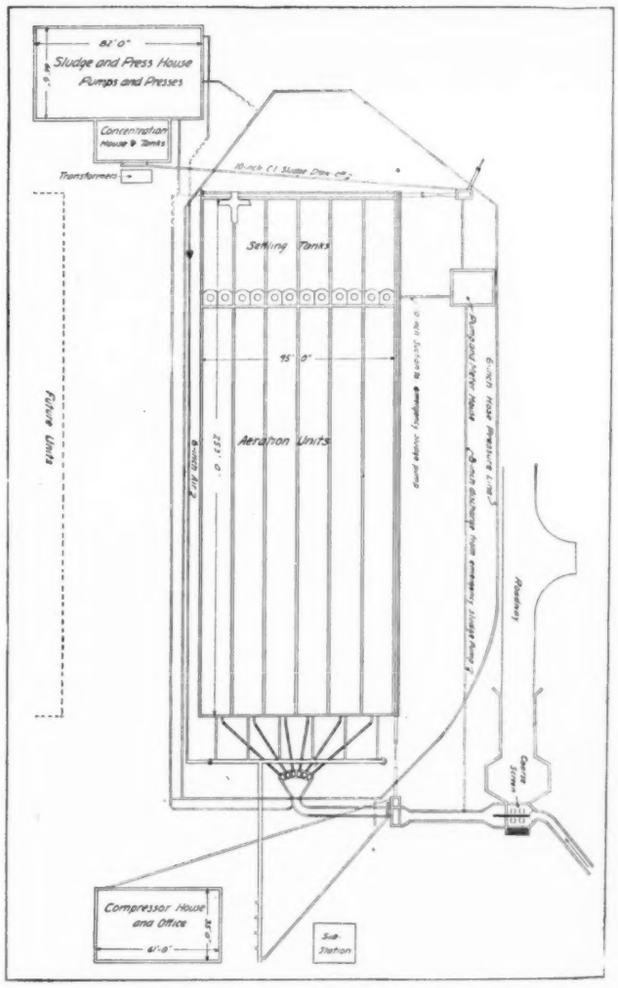
*Superintendent of Plants, Charlotte, N. C.

The city is located astride a ridge with two small streams, Sugar and Irwin creeks, flowing on either side of the divide and the population is very nearly evenly divided upon the two areas. This topographic condition, together with certain other local factors, dictated that two disposal plants, one for each natural drainage area, would be the most practicable



GENERAL VIEW OF IRWIN CREEK

Sewer comes in from the left, entering a coarse screen chamber. A roadway is carried under this, permitting screenings to be dumped directly into a wagon. At the right of this is the power transformer station, then the air compressor house, and at the right of this are the aeration tanks.



GENERAL PLAN OF IRWIN CREEK SEWAGE DISPOSAL PLANT

method for receiving and disposing of the sewage. Each plant is located about six miles below the city.

Though basically both are activated sludge plants, each has several distinguishing features, which tends to make them the more interesting from the designing and operating points of view, as it affords an excellent opportunity for comparison of relative results. At the Irwin creek plant the raw sewage is passed through coarse screens only, before reaching the aerating tanks; while at the Sugar creek plant the raw sewage is passed through both coarse and fine screens and then into a preliminary mechanical settling tank, the effluent from which passes to the aerating tanks.

By far the most interesting difference in these installations, however, is that between the methods adopted for disposing of the solids. At the Irwin creek plant the excess activated sludge is withdrawn from the system and immediately conditioned and dewatered. At the Sugar creek plant the fine screenings, fresh solids from the preliminary sedimentation tank, and the excess activated sludge are digested in separate covered digestion tanks with provision for the complete collection and utilization of gases. This paper will be confined to a description of the Irwin creek plant, with the costs and results of operation, while a later paper will be devoted to the Sugar creek installation.

Construction was started on the Irwin creek plant in February 1927 and completed in March 1928. The plant was placed in preliminary operation in December 1927 and has been in continuous service since. It has a rated capacity of 6 m.g.d., with the present flow averaging about 3 m.g.d.

COARSE SCREEN AND DISTRIBUTION CHAMBER

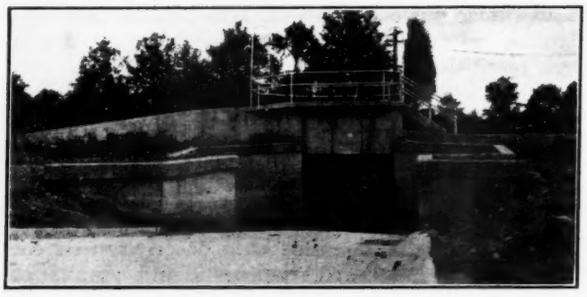
The raw sewage is received through a 36-inch

BOX SCREEN IN FOREGROUND.. SLUICE GATE IN BACKGROUND

Bottom of box screen is a horizontal sluice gate, which can be opened to drop screenings into wagon in roadway below.

DISPOSAL PLANT, CHARLOTTE, N. C.

At the left are the settling tanks.. At the right of these is the filter building, in which the sludge is dewatered by vacuum filters. At the extreme right is the pump house. Sixteen electric lights illuminate the tanks for night maintenance.



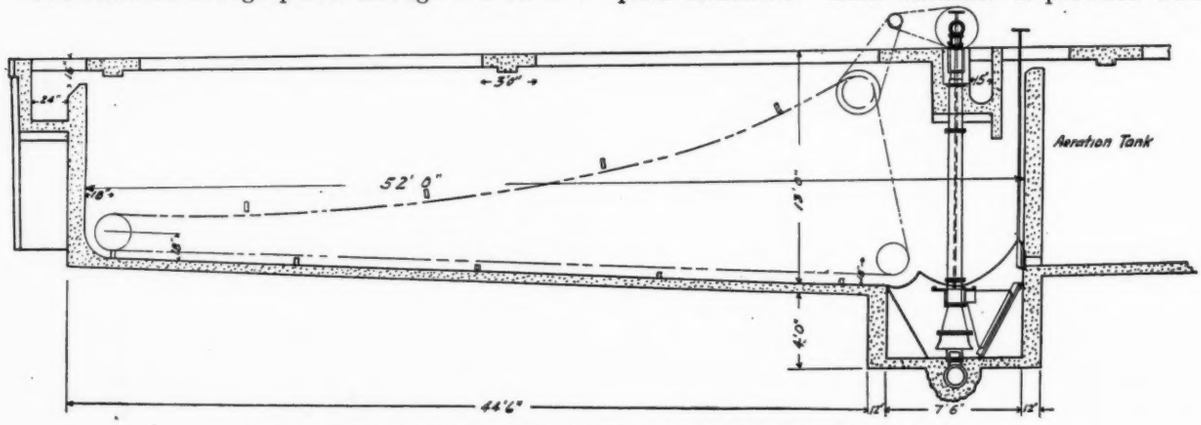
COARSE SCREENING PLANT, WITH UNDERPASS
Sewer reaches screen from the left, leaves it at the right, with a drop in the screen chamber. Screenings dumped directly from chamber into truck in underpass

concrete outfall into the coarse screening plant. This screen is of special design and is a most novel and efficient arrangement. There are two compartments, each of which is provided with two box screens measuring 24 inches square by 20 inches deep, constructed of ¼ inch x 1¼ inch galvanized steel bands with ⅜ inch clearances. The bottoms are solid and operate as sluice gates, which permits of dumping the screenings directly in a dump wagon below. These coarse screenings are disposed of by burial. Sluice gates are provided for changing the flow from one compartment to the other for cleaning purposes. All gates are operated by hand wheels from one operating floor.

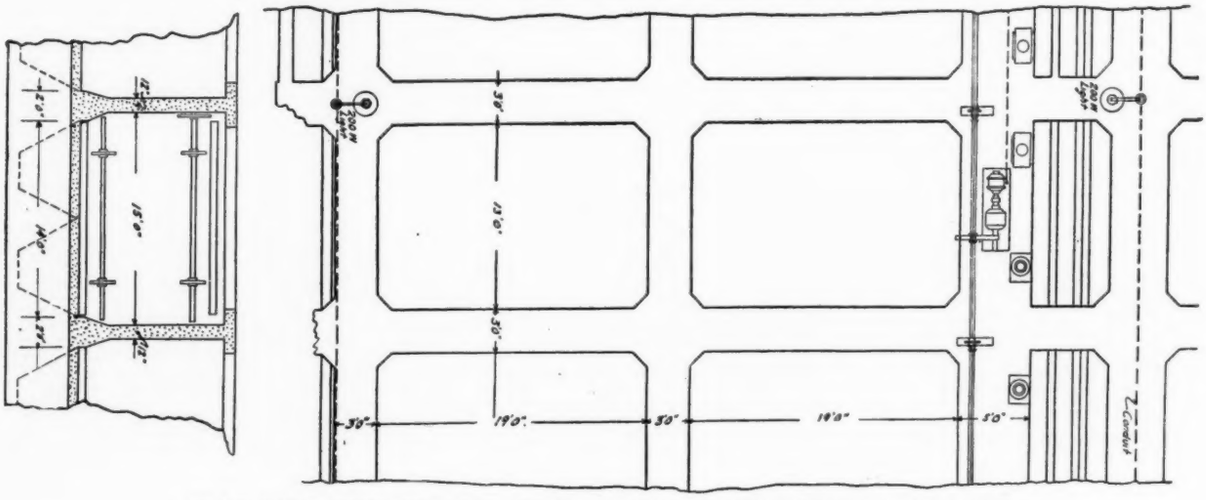
The screened sewage passes through a 2 ft. x 4 ft. concrete duct to the distribution chamber. Between the coarse screen and this chamber the sewage receives the returned activated sludge, which is raised from the returned sludge channel to the concrete duct by air lift. The distribution chamber, by means of adjustable orifices to each aerating tank, permits of distributing the flow of the mixture of raw sewage and activated sludge to the six aerating tanks equally or in any desired ratio. These orifices are of the sliding gate type and are controlled by fixed hand wheels on rising bronze stems. A pointer and calibrated scale indicates the flow to each tank.

AERATION AND FINAL SETTLING TANKS

The six aerating and final settling tanks have a rated capacity of 1 m.g.d. each. Each coupled aerating and setting tank is a complete unit, as they are not interconnected. The aerating tanks are of the straight flow longitudinal ridge and furrow type. Each tank measures 200 ft. x 15 ft. x 11 ft. deep, and at rated capacity allows five hours retention. Each tank contains 504 grade "S" Filtros air diffusion plates. The plates are 12 inches square by 1½ inches thick and are held in place by special aluminum-lined containers, each container holding four plates. An 8-inch cast-iron header, supported from tee beams on the top of the tanks and running the entire tank length, supplies air to the distributing galvanized piping that connect to the plate containers. Each container is provided with



SLUDGE COLLECTING MECHANISM IN SEDIMENTATION TANK



PLAN AND CROSS-SECTION OF ONE OF THE SIX SEDIMENTATION TANKS

a half-inch bleeder pipe terminating at the surface with an ordinary gas cock for venting any water that might collect under the Filtros plates. Bleeder pipes are also provided for blowing out the galvanized pipe headers to the plate containers.

From the aerating tanks the flow passes over a weir wall into the final settling tanks. Each settling tank measures 52 ft. x 15 ft. with a sloping bottom varying the depth from 11 to 13 ft. At rated capacity, the tanks allow a settling period of one and one-half hours. As the flow passes over the weir wall and escapes agitation from the air, there is immediate settlement of the greater portion of the sludge particles into two inverted conical hoppers. The smaller portion of the sludge particles that settle along the tank bottom are scraped to these hoppers by continuously operating sludge collectors of the Link-Belt type. Briefly, these collectors consist of 2 in. x 6 in. x 14 ft. white oak wooden flights attached near each end to traveling sprocket chains. The flights are spaced at intervals of ten feet, there being ten flights in each tank. They travel at a speed of two feet per minute. Two flights in each tank are pivoted to the sprocket chains in order to rake the lower rounded end of the tank.

The tanks and sludge collecting equipment are constructed as simply as possible with the minimum amount of apparatus within the tank, in order to prevent small accumulations of sludge. Every possible provision is made to get all the sludge where it can be immediately removed to the hoppers and forestall any tendency for small accumulations becoming septic and rising to the surface.

Each conical hopper in which the sludge is collected is provided with a wing scraper which revolves snugly around the wall at a speed of 24 revolutions per hour, causing all collected sludge to flow to the bottom of the hopper. From here it is forced by hydrostatic pressure upward through a flared-end 8-in. cast-iron pipe to the sludge over-flow channel. The rate at which the sludge rises is controlled by an adjustable 7-in. seamless brass tube fitting snugly into the upper end of the 8-in. sludge pipe, in which is cut a U notch through which the sludge flows into the sludge channel. This brass tube is capped with a bronze flange to which are attached two threaded bronze stems diametrically opposite each other. Above is a supporting casting containing a fixed handwheel for each stem. The brass tube may be raised or lowered at will by turning the hand wheels and by so doing the head on the sludge overflow is varied. Another advantage of this sludge removal arrangement is that the consistency of the sludge may be varied by changing the elevation of the overflows. In other words, they may be made to pull more or less water along with the sludge. This is often of value in sludge conditioning later on.

NOTCH WEIR IN SLUDGE PIPE, ADJUSTABLE IN HEIGHT TO REGULATE RATE OF SLUDGE DISCHARGE

SLUDGE FLOWING INTO SLUDGE CHANNEL THROUGH U-SHAPED WEIR IN SLUDGE PIPE

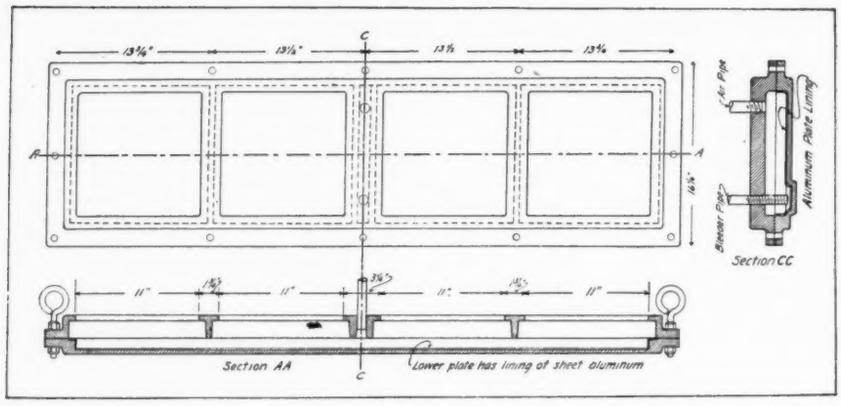
Small hand wheels raise and lower weir pipe to regulate rate of flow

NOTCHED OR SAW-TOOTH WEIR AND EFFLUENT CHANNEL

Both the wing scrapers in the sludge hoppers and the traveling flights are driven from a shafting extending the entire width of the six tanks, which in turn is driven by a 5 h. p. motor. This motor has a speed of 1150 r. p. m. and is direct connected to speed reductions gears to give a shaft speed of 1 r. p. .m. Approximately 75 k. w. h. are required daily for the complete operation of the sludge collecting equipment.

The clear liquid at the surface of the settling tanks passes over a multiple V-notch weir into the effluent channel, from which it is discharged into the stream. This weir is made of a bronze plate, is adjustable as to height by having slotted bolt holes, and in appearance closely resembles saw teeth. It permits of more evenly distributing the flow over the width of the tank than with an ordinary straight weir.

A centrifugal sludge pump with a capacity of 1,000 g. p. m. is provided with its suction header so valved as to permit completely draining any one or more aerating or settling tanks. It discharges into the raw sewage duct, so that any material pumped



CONTAINER FOR AIR DIFFUSER PLATES

passes back though the system by way of the remaining units in service. The only possible discharge from the plant into the stream is over the weir from the settling tank or the clear filtrate obtained from dewatering the excess sludge.

AIR COMPRESSING EQUIPMENT

Compressed air is furnished at eight pounds pressure by three 170 h. p., motor-driven, 3,000 cu. ft. per minute single-stage General Electric compressors. The motor speed is 1,750 r. p. m. with increasing gears to raise the speed of the compressors to 13,650 r. p. m. The oil system is water jacketed with plant effluent pumped for this as well as for general plant cleaning purposes. A Simplex meter indicates and records the total air output, while each aerating tank has a manometer to indicate the air flow to permit of equal distribution. At the present time only one compressing unit is required.

The sewage is being given about 1.2 cu. ft. of air per gallon. About 600 cu. ft. air per minute is required for operation of the air lift.

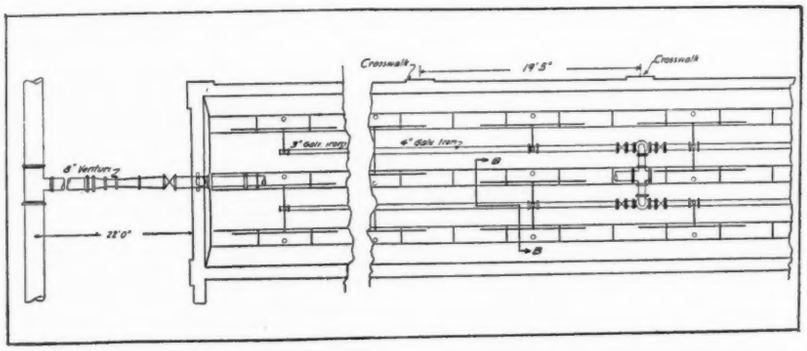
A building 35 ft. x 61 ft. houses the compressors, switchboard and plant office. A separate building 16 ft. x 20 ft. contains the sludge and effluent pumps.

EXCESS SLUDGE DISPOSAL

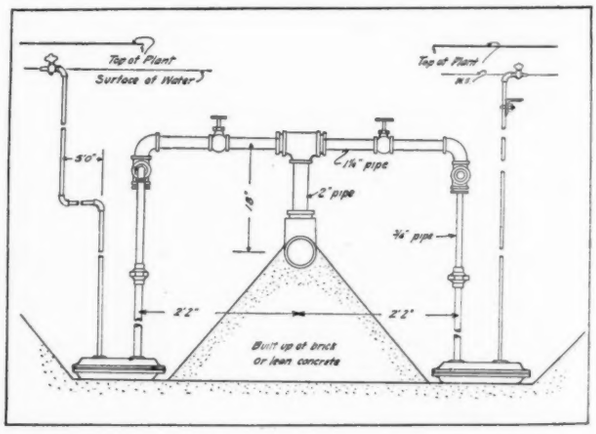
The sludge overflow channel, which runs the entire width of the six tanks, branches at the end of the last tank and runs the entire length of both the aerating and settling tanks. That part along the aerating tanks forms the returned sludge channel and that along the settling tanks forms the excess sludge withdrawal channel. The flow into either channel may be controlled by the insertion of ordinary stop gates into cast frames provided for the purpose. Neither the returned sludge nor the excess sludge channels have any provisions for reaeration.

The excess sludge is discharged by gravity into two conditioning tanks, located under a portion of the filter building, each 20 ft. square by 10 ft. deep and having hopper bottoms running 9 ft. deeper. The bottoms of the hoppers are provided with Filtros plates for aeration and agitation. The tanks are valved to permit use of either or both. The conditioning chemicals are applied to the sludge as it enters the tanks, being fed by two Gauntt dry feed machines located over the tanks. A building with a floor area of 4,300 sq. ft. houses the chemical storage room, feed machines, laboratory and complete filtering equipment.

From the conditioning tanks the sludge is pumped by two motor-driven, 50 g.p.m. Goulds plunger sludge pumps to the Oliver filters. There are two of these vacuum filters, each having a capacity of 3,000 gallons per hour of sludge containing one per cent dry solids and giving a cake not exceeding 85% moisture. They are 8 ft. x 10 ft. ordinary drum type, covered with wool flannel and revolving under vacuum partially submerged in a hopper filled with sludge. The vacuum is produced by three motor-driven belted vacuum pumps with a capacity sufficient to produce 20 inches of vacuum. An overflow leads from the filter hopper back to the conditioning tanks to take care of any sludge that might be pumped in excess of the amount that the filters can handle The cake produced by the filters is deposited upon a belt conveyor running to the outside of the building, where it dumps directly into farm manure spreaders. A tractor trails the spreaders



PLAN SHOWING ARRANGEMENT OF AERATION PLATES AND PIPES

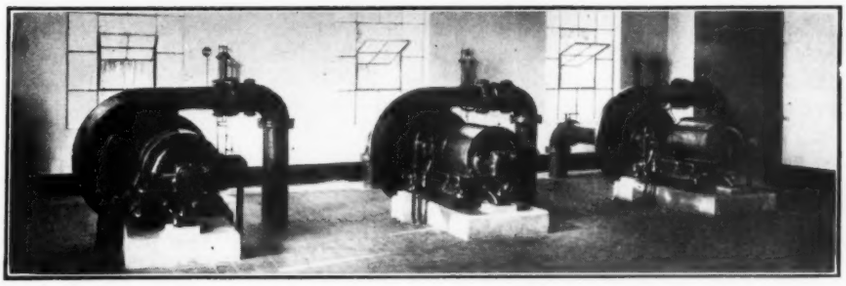


AERATION PLATES AND PIPES. SECTION AT BB

to adjoining farm lands, spreads the sludge and immediately plows it under.

GENERAL CONSTRUCTION

The general type of construction and the appointments of the entire plant are somewhat of a radical departure from the ordinarily accepted standards, at least in this section of the country. The three buildings are of first-class reinforced concrete with exteriors of red tapestry brick and cast slab trimmings. The interior is painted white, and all metal equipment black. The floor of the compressor house is of red tile while those of the other two buildings are hardened concrete. The office and laboratory floors are covered with heavy cork linoleum. Windows are steel sash with factory ribbed glass. Complete lavatory, bathing and toilet facilities are provided for the operating personnel. The office and laboratory are electrically heated, are inclosed with steel and glass partition with all doors and windows provided with copper screens.



CENTRIFUGAL AIR COMPRESSORS AT IRWIN CREEK PLANT
3,000 c. f. m., 8.8 lb. per sq. in., 13,650 r. p. m. geared to 170 h. p., 2200 volt, 60 cycle squirrel cage induction motors

Concrete driveways, 20 ft. in width, surround the buildings and tank structures. A 6-in. cast-iron pipe system, containing plant effluent under a normal pressure of 40 pounds and having several hydrants located at strategic points, supplies ample water for cleaning purposes. A sanitary water supply is provided from two nearby springs by a small automatic pump. The entire layout presents a most attractive appearance and has been widely commented upon.

OPERATING PERSONNEL AND EQUIPMENT

The plant is operated under the general direction of the Commissioner of Public Works. The superintendant of plants has direct charge of both the Irwin and Sugar creek disposal plants and the water purification plant. The day operating force consists of the foreman, chemist and three laborers, while the evening and night shifts are each manned by an operator and one laborer.

The sludge handling equipment consists of four ordinary farm manure spreaders and a tractor for trailing them to the spreading site, and a pair of mules for plowing and general draft use. The plant is exceptionally well tooled for general repair and maintenance work.

LABORATORY ROUTINE

The laboratory is fully equipped for making all routine analyses required and for making sludge conditioning tests.

Daily determinations are made of the influent for suspended solids, dissolved oxygen, pH, bio-chemical oxygen demand and bacteria. Each aerating tank is run daily for thirty-minute settleable solids, dry solids, and pH. The sludge is run for dry solids and pH; the effluent for suspended solids, dissolved oxygen, bio-chemical oxygen demand, stability, nitrates, pH and bacteria. The creek above and below the plant discharge has daily determinations of suspended solids and dissolved oxygen. Before any filtration is attempted, test runs are made in the laboratory by the Buchner funnel method with varying doses of conditioning chemicals to determine the most economical treatment. The laboratory has facilities available for making any additional ordinary determinations that might be required.

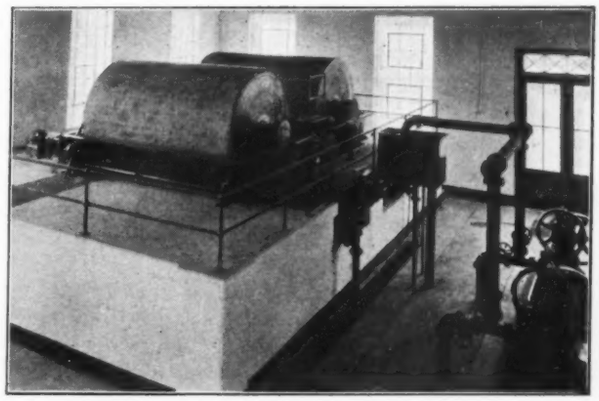
PRELIMINARY OPERATING RESULTS

During six months operation the plant has produced very satisfactory results. It usually requires at least this length of time to get a plant of this character functioning properly, and even better results are anticipated. The effluent is clear at all times, contains a considerable amount of dissolved oxygen, has a low oxygen demand and is very seldom not stable at the end of twenty days. Following are some operating results, in parts per million, for the past three months of 1928:

	Suspended Matter		Dissolved Oxygen		B. O. D.		Stability
	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Eff. Days
March	202	50	0.7	4.4	....	....	5 Plus
April	215	42	1.0	6.5	....	....	5 Plus
May	220	34	0.8	6.2	890	60	5 Plus

Ferric chloride and alum have been used as sludge conditioning chemicals. Approximately eight pounds of ferric chloride per thousand gallons will condition the sludge under average conditions. From ten to fourteen pounds of alum is required per thousand gallons of sludge when alum can be used at all. Ferric chloride is efficient at all times. A considerable amount of experimental work is now being done to determine the most economical use of conditioning chemicals.

An average of seven tons of 80% moisture filter cake is being produced daily and has been spread upon grounds immediately adjoining the plant build-



THE OLIVER FILTERS

ings, plowed under and planted without any appreciable odors. It appears that there will be no trouble whatever in disposing of this cake upon the 1,000 acres of land adjoining the plant and owned by the city.

One of the chief demands upon the operating force is that the plant and grounds be kept absolutely clean at all times. The tanks and coarse screen are washed daily with a hose and all floors are swept or mopped daily. No trash or loose material is allowed in the buildings or on the grounds at any time. The grounds have been graded, sowed in peas for the summer, and will be planted in grass or alfalfa at the proper time. Charlotte has long enjoyed an enviable reputation for the cleanliness of her water purification plant and there is no logical reason why this disposal plant may not achieve a like reputation, especially since ample facilities are provided for the purpose.

CONSTRUCTION COSTS

Exclusive of engineering, the costs of construction are as follows:

General contract	$212,000
Cast-iron pipe and fittings	10,500
Filtering equipment	31,000
Air compressing equipment	18,000
Sludge collectors	13,500
Miscellaneous	25,000
	$310,000
Land	110,000
Total	$420,000

OPERATING COSTS

Monthly operating costs for the complete operation of the plant are approximately as follows:

Power (90,000 k.w.h.)	$1,364	
Labor and superintendence	900	
Chemicals	85	
Supplies	50	
Miscellaneous	35	
Total	$2,434	
Cost per M.G. (3 m.g.d.)		$27
Adding fixed charges:		
$310,000 @ 6%	$1,550	
Total	$3,984	
Cost per M.G. (3 m.g.d.)		$44.25

CONTRACTS

The following firms were awarded the contracts for the construction work and major equipment items:

General construction contract	McClelland Co., Charlotte
Electrical " "	Harrison-Wright Co.,
Filtering equipment	Oliver Continuous Filter Co.
Sludge collectors	Link-Belt Co.
Cast-iron pipe and fittings	Glamorgan Pipe & Foundry Co.
Valves	Grinnell Company
Air compressors	General Electric Co.
Meters	Simplex Valve & Meter Co.
Laboratory equipment	Fisher Scientific Co.

The plant was designed and construction supervised by W. M. Piatt, consulting engineer, Durham, N. C. H. P. Redding was resident engineer. Construction work was carried forward and the plant is now being operated under the general direction of Hon. Robert L. Brown, Commissioner of public works. The writer is superintendent of the city plants. A. Wayt Thomas is city engineer. E. L. Nance is general foreman and the plant is under his direct charge.

DITCH AT SEBRING AS IT APPEARED THIS SPRING

Ventilation of Chlorinating Apparatus Room

At the water purification plant at Fisher's Island, New York, special precautions are taken for preventing accidents from chlorine leaks. The room in which the chlorine apparatus is located is on the ground floor of the plant and has one outside wall with a window affording light and natural ventilation. A door with a glass panel connecting this room with the rest of the building affords a view of the equipment from the outside. Artificial ventilation is provided by a small motor-driven ventilating fan in the outside wall at the floor level, controlled by a switch located outside of the room near the door opening into it. By means of this fan, chlorine gas escaping into the room can be forced into the outside air. If it should become necessary to shut down the chlorination plant for cleaning or repairs, the chlorine tank can be opened and the fan started to remove the residual gas, making it possible to carry out repairs much more rapidly than would otherwise be possible.

Dynamiting a Drainage Canal

Under this title we described, in our issue of November 1926, the construction of a canal for lowering the level of Lake Jackson, at Sebring, Fla. This canal was 3,000 feet long, 22 feet wide at the top and 3½ feet deep, in black muck, through a dense growth of trees and underbrush. After cutting down the trees, 50 percent Dupont dynamite was used to remove the soil. Illustrations accompanying the article showed the canal before and after blasting.

On an inspection this spring, the canal was found in very good condition. The current had however, deposited a quantity of sand in the bottom and before many years it will be necessary to remove this to maintain the flow required to keep the lake at the desired level.

The accompanying illustration shows the appearance of the canal a few weeks ago.

Three Hundred Million for Texas Roads

The chairman of the State Highway Commission of Texas, R. S. Sterling, is advocating the issuance of three hundred million to three hundred and fifty million dollars of thirty-year state bonds for the

construction and improvement of highways, to extend over a period of about twelve years. It is proposed that the proceeds from this bond issue be expended at the rate of fifty million dollars the first year, forty million dollars the second year, thirty million dollars the third year and twenty million dollars each year thereafter. The money necessary to pay the interest on the bonds and to retire them would be raised by means of the gasoline tax.

In addition to utilizing as much of the money on highway improvements as can be spent annually, efficiently and economically, it is proposed to reimburse all the counties for money they have spent on state roads since the organization of the State Highway Department, the amount to be proportioned to the appraised value of the roads at the time the new program goes into operation. The reimbursements are to be paid in annual instalments and the money so paid is to be used for improving lateral roads in these counties. It is estimated that the total amount of money contributed by counties thus far to the state road building program is about fifty million dollars. By paying this money back to the counties over a period of years, sufficient funds will be available to carry on a large program of primary highway construction, the speed with which it could be pushed to be limited only by the amount of materials available in the state without causing a scarcity and higher prices.

The three-cent gas tax now provides about twelve million dollars current highway revenues a year, and it is estimated that this would more than take care of a three hundred million dollar thirty-year bond issue, "taking into consideration the rapid increase in gasoline consumption and the even greater increase to result from the multiplied traffic which good roads would bring."

It will require a constitutional amendment before such a bond issue can legally be adopted.

Estimating Cost of Road Work

Many contractors have no standard method of arriving at the total cost of a contract or of estimating on the probable cost of work upon which they expect to bid. Even these, however, will probably admit that a system of making estimates and keeping costs is desirable. In fact such a system is necessary if a firm is to operate successful on a business basis. "The Low Bidder," the official publication of the New York State Highway Chapter of the Associated General Contractors of America, in its May issue publishes the form used by the Bricon Construction Company as an excellent form to be used for this purpose.

This form divides the expenditures under the heads of "imported materials," "local materials," "producing labor," "construction expenses, fixed," "construction expenses, current," "administrative expense," "general expense," and "financial expense." Under the head of "construction expenses, fixed" it includes fire insurance, taxes, bonds, compensation insurance, and public liability. Under "construction expenses, current" it lists fuel (coal, etc.), gas and oil, machinery parts, construction supplies, trucking expenses and rentals, erecting plant, freight on plant, demurrage, superintendent's expenses (not salary), dynamite, fuse, etc., temporary buildings, depreciation on plant. Under "administrative expense" are listed office salaries, office supplies and expenses, office rent, railroad transportation, motor transportation, hotel expense, legal expense, telephone and telegraph, medical service, executive insurance, employment bureau expenses, timekeeper's salary, engineer's salary, advertising, donations, superintendent's salary, executive salaries. Under the head of "general expense" are listed taxes (income), commissary loss, commissary salary loss. Under "financial expense" are included interest on notes and the discount on notes.

The total cost of the road then is made up of the items of total cost of imported materials + total cost of local materials = total cost of material; total cost of labor; construction expense, fixed + construction expense, current = construction expense total; administrative expense + general, expense + financial expense = total overhead expense. To this total cost of road is added prospective profit, giving the total bid price.

The sheet for making up the bid contains a line for each contract item, opposite which are columns for units; quantity; producing labor per unit and total; cost of material, both imported and local, unit cost and total; the bid price; and the total for that unit.

Asphalt Penetration Pavements

Suggestions concerning some details involved in constructing and maintainng macadam roads of this type.

By F. H. Gilpin*

For certain ranges of traffic load and density, the development at the lowest cost possible of a smooth, even-riding surface which can be maintained in continuous good condition at a minimum expense over a definite number of years, of ample width for the traffic density and of ample depth for the traffic tonnage load, can be secured by the use of penetration macadam where suitable material is available and certain details of design and construction are followed.

Engineers are all familiar with the general construction of a penetration macadam road, but a few words on details of design which are many times neglected and the reason for their importance may be of interest.

CONSTRUCTION

The actual total depth of pavement construction depends on the traffic requirements and supporting power of sub-grade and varies from five to eighteen inches. For a normal coarse, well-drained sub-grade a nine-inch pavement seems to be what might be called standard for general trunk line construction. Owing to the natural flexibility of this type of pavement, it will endeavor to keep in direct contact with the sub-grade. Every precaution must be taken, however, to have the sub-grade of uniform supporting value throughout. This is accomplished

*Engineer, The Texas Company.

OLD ROAD READY FOR PENETRATION MACADAM SURFACE

by rolling and by removal and replacement of all areas below the standard for the particular road. Any soft spots left in will result in low areas in the surface after traffic begins to give its attention to compacting in detail. Too frequently macadam roads are constructed at considerable expense for the pavement without due regard to the preparation of the sub-grade or proper drainage, either of which may cost more than the pavement. Their proper handling, however, will ensure long life and low maintenance.

In the selection of aggregate, great care should be used. A tough, hard crushed stone which does not air or water slack, and which breaks in a rough cubical form, is satisfactory for coarse aggregate. Limestone, granite, trap and hard sand stones are usually satisfactory, but selection depends a great deal on the traffic the road is to carry. The usual size of coarse aggregate for top course is 1¼" to 2½". For soft stones the size should be increased to 2½" to 3½" to take care of the internal wear. For roads carrying less than 300 vehicles per day, any available supply of local stone which does not air or water slack may be used. Crushed slag weighing at least 1,800 pounds per cu. yd. loose has been used extensively and with success for the foundation course, but should never be used on the top course for heavy traffic roads as it wears and crushes too easily. Great care should be exercised by the inspector or engineer in charge in examining the stone to see that a uniform, clean grade of stone is used.

In spreading the stone on the road, all small pockets of fine stone which invariably occur must be dug out and replaced with well graded aggregate. After a preliminary rolling, the road should be carefully inspected for hollows and bumps. This stage is the proper time to eliminate all defects and inequalities by removing bumps and adding well graded aggregate to the hollows. Under no conditions should small hollows be brought to grade by adding fine material.

SPREADING KEYSTONE OVER FIRST APPLICATION OF ASPHALT

The road is then rolled moderately firm. There is a great deal of discussion on the proper amount of preliminary rolling for a penetration macadam road, but the best results are obtained when stone is rolled until it is firm and well consolidated, the stone is interlocked, and ceases to creep in front of the roller. The stone, however, should not be rolled until it tends to crush and powder under the roller.

The result of the rolling should be a surface in which the voids are uniform.

In applying the asphalt, care should be taken to see that material is not overheated. Overheating causes the asphalt to lose life, and when underheated the flow of asphalt is not free and it spreads poorly. In applying by either hand or machine, overlap must be prevented, as waves and bumps occur at these points a little while after the road has been opened to traffic. After the asphalt has been spread, the road should be examined carefully to see that the

KEYSTONE SPREAD, READY FOR THE SEAL COAT

spread has been uniform and has penetrated the top wearing course. Where pools of asphalt occur, the top course must be dug out, replaced with well graded aggregate, rerolled and the asphalt repoured.

All specifications state that the stone must be clean and dry before applying. Under no circumstances should asphalt be applied if the stone is dirty; but a slight dampness is not injurious as long as no hissing sound is produced when the asphalt is applied at a temperature of around 325 deg. F.

Immediately after the asphalt has been applied, a thin layer of clean, hard ¾" chips should be spread over the surface. The chips should be spread with a fan-like sweep. If the stone tends to bunch, it should be broomed out to an even surface.

The surface then should be rolled lightly; continual rolling is injurious, tending to produce waves in the surface. After the asphalt has hardened, the road then may be thoroughly rolled and shaped to advantage. Great care should be used in all rolling operations not to suddenly reverse the roller. The roller should be easily brought to rest and started gradually.

Before the seal coat is applied, all excess chips not imbedded in the top course should be broomed off. The seal coat properly spread serves two purposes. First, it finally waterproofs the finished wearing course. Second, it serves to hold in the final layer of stone chips that complete the wedging of the surface layer and take part of the wear. The

exact amount of asphalt to be spread is governed by the size of the remaining openings in the surface after the keystone are rolled.

Over the seal coat is spread as much small stone as can be imbedded in the asphalt by thorough rolling. As many pavements are completed late in the season—too late for traffic to give it that final kneading so necessary to its success—a second light seal coat of a medium hot oil often is applied to carry over the winter.

MAINTENANCE

One of the great advantages of penetration macadam is the ease and cheapness of maintenance. Large and shallow holes may be treated in two ways, by use of a cold-patch mixture or by hot patching. Cold patching is preferred to hot patching by some engineers; the cost of both is about the same. However, in cold weather a better patch is obtained by the hot method.

For patching shallow holes or depressions, the surface is swept clean and a paint coat is applied to the edges of the hole to be patched. Then the cold patch or stone, depending upon the method used, is placed in the depression, smoothed to the contour desired and then tamped. If a hot patch is used, the asphalt is spread uniformly over the stone, but great care should be taken not to pour in an excess for then the patch will shove later. Clean screenings or coarse sand are spread over the patch and if possible rolled, as a more even, firm and consolidated patch is obtained by the use of a roller.

For deep depressions or where the road has ravelled, the holes should be cleaned to the bottom, all loose and disintegrated material should be removed, and edges should be cut back vertically. The hole should then be painted on the edges and sides and filled with 2″ or 1½″ stone, depending on depth of hole to be repaired. The patch is afterward tamped. If cold patch is used, the hole should be filled to within 1″ of the surface, tamped and the balance filled with ¾″ stone mixture and again tamped. The patch is then sealed or painted with asphalt, covered with screenings or coarse sand and rolled.

When the condition of the surface indicates the need, a penetration macadam road may be surface treated. The length of time between surface treatments depends upon the traffic carried by the road and the kind of asphalt used in previous treatments. Probably the best and most economical surface treatment is with a hot application surfacing material containing approximately 75% of asphalt, covered with stone chips. In surface treatments all holes and depressions should be repaired, the surface should be swept clean down to the stone surface, which should present a mosaic appearance. The oil should be heated to the proper temperature for application, care being taken that it is not overheated or underheated, and only as much oil should be applied as the road surface will absorb. Care should be taken that all excess oil is broomed from depressions. The surface is then covered with stone chips, the amount of covering depending upon the amount of oil used. A great many engineers prefer then to roll the road, but this is unnecessary unless a road asphalt has been applied, in which case rolling is preferable to traffic ironing out the surface.

CLOSE-UP OF COMPLETED ASPHALT PENETRATION MACADAM SURFACE

Highway Legislation by the Seventieth Congress

Five major pieces of legislation concerned with highways and involving $239,200,000 were passed by the 70th Congress. These were the $165,000,000 Federal-aid bill; the $66,000,000 automobile excise tax elimination bill; the $4,200,000 appropriation for the Mt. Vernon Memorial Highway; the $4,000,000 flood relief measure for reconstruction of Federal highways in the States of Vermont, Kentucky and New Hampshire, and the Oddie amendment to the Federal Highway Act.

The amendment marks the first step that the Federal Government has taken in beautification of the Federal highway system. It authorizes the planting of trees along the Federal-aid route, and provides that the Federal government shall share with the states on an equal basis, the original cost of tree planting and maintenance.

In addition to the bills passed, three joint resolutions were adopted, the first authorizing a $15,000 appropriation to send American delegates to the Second Pan-American Congress on Highways at Rio de Janeiro; the second authorizing $25,000 expenditure for the Federal Government to entertain delegates to the Permanent International Association of Road Congresses, which will hold its sixth session in the United States in 1930, and the third authorizes the appointment of a commission to study the construction of a North-American Highway traversing North, South and Central Americas.

Figures compiled by the American Motorists' Association show that on July 1st there will be a total of $241,115,000 of Federal funds available for the Federal-aid highway program. Of this sum $128,000,000 is available for projects now under construction; $29,000,000 for projects not yet begun but which have been approved, and $84,115,000 for new construction projects.

Removing Dust From Refuse Before Incineration

The city of Blackburn, England, with a population of about 126,500, disposes of all of its refuse (ashes, garbage and rubbish mixed) in an incinerator. For several years there had been considerable complaint on account of dust emitted from the chimney which fell on all the surrounding territory. In order to

meet these complaints, a dust extraction or separation plant was installed in 1923 to remove the dust from the refuse before incineration. The result has been very satisfactory.

The crude refuse is discharged onto a 24-inch conveyor belt which carries it to an externally driven rotary screen 12 feet long and 6 feet diameter, with a mesh of one half inch. The dust separated in the rotary screen is collected in a steel bin with a capacity of 15 tons. The underside of the bin is sufficiently raised from the ground to discharge directly into a motor truck beneath it. It was found that about 35% of the refuse reaching the works consisted of fine dust, varying from 50% in dry weather to 25% in wet weather. The dustless tailings are discharged from the screen onto a distributing conveyor fitted with scrapers for removing the refuse to storage pits. Boys are employed in removing from the belt such articles as bottles, tin cans, paper, etc.

After the elimination of the dust it was found that the incinerator would burn 30% more refuse than before. Enough cinders and coal are found in the rubbish to maintain steam in the boiler which operates the plant when mixed with a small percentage of coal. Presses are used for baling the tin cans and the paper, which are sold. The dust is used on clay land for top dressing lawns and for tennis courts. It possesses some fertilizing value but its action on the soil is mainly physical.

Garbage by the Cord Foot

In the annual report of the Department of Public Works, of Waltham, Mass., for 1927, we find statistics concerning the amount and the cost of collecting ashes and garbage in that city. The amount of ashes is designated by the autocar load and the double team load, which figures are converted into cubic yards, the cost of collection per cubic yard having been 8 cents and the cost per capita for the year 75 cents.

When it comes to garbage collection, however, we find the amount of garbage collected expressed in "cord feet" and the cost per cord foot is given as $3.57, or 79 cents per capita. This seems to us an unusual unit for indicating quantity of garbage, and it would be interesting to learn the origin of the unit and why its use is continued; also why the figures have not been converted to cubic yards, as the loads have been converted into cubic yards in the case of ashes.

Refuse Incinerator for White Plains

White Plains, N. Y., put into operation during March a refuse incinerating plant which is housed in a building of yellow brick with a green tile roof, located near the Mamaroneck River Parkway. The plant cost about $155,000. It is of the Nye type having three furnaces, each capable of handling 50 tons of mixed garbage and refuse in twelve hours. At present only about 50 to 70 tons is being incinerated daily at the plant.

In addition to White Plains, other New York cities which have erected incinerators during the past year are Buffalo, Freeport, Huntington, Niagara Falls, Port Washington, Tonawanda, Utica, Valley Stream.

English View on Rapid Sand Filtration

City engineer of Cork describes plant at that city and compares it with American practice, considers subsidence tank unnecessary, and either air or mechanical stirring necessary

The older members of the engineering profession can remember when advocacy of rapid sand filtration for purifying water was looked upon as commercial quackery; and even the younger engineers can remember when this method of treating water was looked at askance in New England as well as in old England. Now, however, it is generally accepted in the former and has been coming into general practice in Great Britain. In a recent paper presented before the annual meeting of the Irish District of the Institution of Municipal and County Engineers, S. W. Farrington, city engineer of Cork, Ireland, discussed some features of rapid sand filtration, comparing the practices which he found in the British Isles with those which he learned were common practice in America.

As a result of the comparison he reached the general conclusion that there is much more standardization in American than in British practice. He was surprised to find that American practice did not generally include automatic control, but appeared to rely more on close supervision, saying that:

"As an example, the American Water Works Association states: "Automatic control of chemical feeding for proportioning in accordance with water flow is sometimes used, though not generally regarded as advantageous;" on the other hand, every British scheme examined included some automatic means of varying the dose in proportion to the flow of crude water. The following are the various devices used: A variable speed motor regulated by the flow of crude water; a turbine driven by the crude water operating a pump supplying the dose; a movable weir actuated by a float.

"The Candy Filter Co.'s plant installed at Cork incorporates a movable weir over which the solution of alumino-ferric flows into the mixing race; this weir is raised or lowered by a float the level of which depends on the volume of crude water entering the filters.

"The process of coagulation itself may be divided into two parts—reaction and flocculation. In America the reaction consists of ten to forty minutes of violent agitation, and the flocculation or quiescent period from two to six hours. British firms provide a comparatively short reaction period and present the utmost variation in their views as to the necessity for flocculation or subsidence. In the schemes submitted for Cork some allowed for a sedimentation of six hours, some three and a half, some one, and some omited subsidence altogether.

"The only point of uniformity appeared to be in providing a short period of violent agitation immediately following the application of the chemical.

"The accepted scheme provided for no subsidence tank.

USE OF SUBSIDENCE TANKS

"When it is considered that a subsidence tank of six hours' flow capacity may cost, say, from 30 per cent to 50 per cent of the whole cost of the plant, it is obvious there must be a very real reason for such a wide variation in practice.

"In searching for this reason it appeared there was a distinct conflict, if confusion is too strong a word, in the theory of the flocculation or sedimentation tank. The advantages claimed for it are: (1) Economy of chemical by allowing complete reaction; (2) saving in wash water by reducing the quantity of impurities intercepted in the filter.

"Evidently if chemical can be saved by installing a flocculation tank its advantage is a question of financial calculation. As mentioned, the plant at Cork has no quiescent subsidence period, and the influent to the fiilters contains no floe in the strict sense of the word—*i.e.*, no feathery aggregations of the precipitate; however, a finely divided precipitate is quite apparent to the eye. The chemical has been thoroughly mixed by passing through a race with vertical baffles, which produce great turbulence. The dose of alumino-ferric in normal times is two grains per gallon, and is increased to three and a half grains when the river is brown. This is a heavy dose, and has been found to be necessary.

"The writer calculates that if a five-hours' flocculation tank would save half the chemical, and if the plant worked at full capacity all the year round, the saving would just pay the interest on the cost of the tank. His opinion is, however, that no such saving would result. Experiments show that in normal times the dose which produces a satisfactory bacterial reduction is not sufficient to deposit a visible precipitate in a perfectly quiescent jar in six hours.

"It is therefore hardly to be expected that much effect would be produced in a partially quiescent subsidence tank. No added alumina has been detected in the effluent from the filters, so it is not staying in solution. When the water is highly coloured the dose has to be increased to get a clear effluent; the bacterial reduction is then at its best. It seems probable that when the river is highly coloured a subsidence tank might reduce the necessary dose, but as this represents only a small fraction of the time no very material saving in the year would be effected.

"The writer is inclined to the opinion that the necessity for a sedimentation tank depends on the dirtiness of the crude water and the efficiency of the washing apparatus rather than on the time required to induce chemical reaction.

"It will be noted in this connection that the American use of large subsidence tanks is accompanied by relative simplification of the washing arrangements.

"The theory of flocculation, viz., that coalescence is induced by neutralizing chemically the electric charges which keep the particles of colloidal matter apart and so permitting them to form a floc, does not require that this aggregation should take place under the action of gravity in a quiescent tank. It seems reasonable to suppose it could take place with great rapidity when the particles are forced into close proximity by passing through the infinitesimal orifices left when a sand filter is partially clogged with coagulant.

"It is not intended to imply in anything that has been said that subsidence has no useful function in water purification, but the fact that such a great diversity of opinion exists as to the best method of economically treating a given water suggests that investigation into this question might be amply repaid.

"It is apparent that if a water is not dirty enough to warrant subsidence it may even be a disadvantage.

"The writer has seen reference to the need of adding additional coagulent to the effluent from subsidence tanks because flocculation and subsidence had been too thorough, and insufficient coagulant remained to film the sand bed.

RATE OF FLOW

"Filtration proper varies in practice principally in the rate of flow and in the construction of the draining floor of the filter. All the schemes submitted for Cork provided a rate of flow between 70 and 80 gallons per square foot per hour, with the exception of one proposal, where the downward rate was as high as 130 gallons per hour. The rate of flow bore no relationship to the length of time the crude water had been submitted to subsidence.

"Indeed, the proposal referred to provided for no subsidence at all. The rate of flow of the accepted scheme averages 75 gallons per square foot per hour, this being, apparently, a popular average in British practice. Comparing this with American practice, it was found that certain experiments carried out in America and concluded in 1907 had tended to stabilise practice to adopting a rate of flow of 100 gallons per square foot per hour. When deviation is now made from this rate it is on the high side, so it appears that on the average the Americans favour a higher rate of flow.

THE FILTER FLOOR

"The purpose of the filter floor is to collect the filtrate into the effluent channel and to distribute the air scour and upwash. It is principally to this latter function that it owes its complication.

"The Candy floor at Cork is fairly typical. Rows of 3-in. diameter earthenware drainpipes are laid on the concrete base 6 in. apart, centre to centre, and leading to a central collecting channel. Into the top of these pipes brass nozzles are screwed, the whole being carefully levelled and flushed up with fine concrete. The patent nozzles are spaced four per sq. ft. and incorporate separate apertures in the stem for air and water.

"It is claimed for this system that it gives a very even distribution of the air scour and upwash, and this claim has been fully vindicated at Cork.

"The Cork plant, in accordance with general practice, is fitted with an automatic control on the quantity of water flowing into the filter; the effluent from the filter is also controlled by a float operated to compensate for the gradually increasing resistance of the sand bed as it becomes clogged. The need for washing is indicated by an electric bell which rings when the head absorbed by the filtering sand rises to the predetermined maximum."

WASHING FILTERS

In the matter of washing filters he was surprised also to find that American practice relied upon water

alone without either air or mechanical stirring, while one or both of these are considered essential in the British Isles.

Most of the schemes offered at Cork provided for air scouring, but mechanical agitation with revolving arms also had its advocates. In this connection he stated that this simplification of the wash is accompanied by the use of large and expensive subsidence tanks and they are probably necessary. The writer is of the opinion, however, that either an air scour or mechanical agitation is necessary, and in proof gives the following quotation from a paper by Messrs. Whipple & Chandler on Rapid Sand Filtration at Cambridge, Mass., read before the New England Water Works Association:

"The routine washing of beds with high velocities and prolonged application of wash water does not suffice alone to keep the sand clean and to prevent caking and the formation of mud balls in the sand. Two special methods of treatment have been found necessary to maintain satisfactory conditions—hand raking around the sides, and treatment with caustic soda.

"Hand raking is carried out every ten days, one bed being so treated each day. This practice requires two men, each of whom handles a rake with ten-inch tines set at right angles to a long wooden handle. From the walls of the filter the rake is worked up and down in the sand during a wash. Mechanical agitation effectually breaks up the mud that forms along shrinkage cracks. These cracks do not form in the center of the beds. Conditions at Cambridge are not unusual for rapid sand filters. Reports have come from other plants of various methods devised to increase agitation that is provided by the triple washing with water. These attempts recall former practice that made use of the air wash and mechanical stirrers.

"The wash water pumped was 660,000 g.p.d., of which 170,000 gallons remained on the beds after washing, leaving 490,000 gallons wasted to the sewer. The wash water was therefore 3.6 per cent of the total filtered. The average period of filter service was 12.2 hours, the maximum monthly average being 18.7 hours, and the minimum 6.6 hours. Losses of head ranged, as an average, from 0.9 ft. initial to 8.5 ft. final. This last is a maximum beyond which normal rates of filtration cannot be maintained."

Commenting of this, he says: "Although mechanical agitation is not provided as part of this plant, it is, nevertheless, carried out in what even in slow sand filters would be considered rather a barbarous fashion. The percentage of wash water is very high. These filters were on easy duty with an average working day of twelve hours. After six months' practically continuous duty at Cork there are no signs of mud balls or contraction cracks, due probably to the very efficient air scour."

A novel feature in the Cork plant, which is a peculiar feature of the Candy type of plant used there, is that there are no wash water troughs but the wash water is taken off over a low weir situated at one end of the bed. This weir is only a few inches above sand level and the sand surface is really swept by the wash water in a horizontal direction. As there is no need to lift the impurities to any considerable height, the vertical velocity of wash water is reduced to a minimum—actually about 6¼ gallons per square foot per minute. The sand is prepared for up-wash by an air scour at a pressure of about 4 pounds a square inch.

Duplex Main Water Distribution

Opinions of several hundred water works superintendents as to conditions under which this system is desirable. More than three-fourths favor it under certain conditions

Among the questions asked in a questionnaire sent by Public Works a few weeks ago to water works superintendents throughout the country, was one referring to the practice of laying two mains, one on each side of the street, which has been called the "duplex main" system of distribution.

The two principal advantages claimed for this construction by its advocates are that it saves cutting up the pavement of the roadway in making connections between the main and the house; and that, if the street is wide, it is actually cheaper to lay the second main than it is to lay the long house connections required where only one main is used. The former advantage is always present unless house connections are laid prior to the paving of the street, and a great many water works men are seriously opposed to this procedure. The second advantage, from a purely financial point of view, can be calculated and depends upon the lengths of services necessary, the cost of laying service per foot, the distance apart of the residences, and the cost of the secondary main, which is usually of small pipe, 2 to 4 inches diameter.

The questions asked were: "Do you prefer a main on each side of the street to one main and long service?" "Have you laid any such duplicate mains?" "How wide do you think a street should be to justify two mains?"

Approximately one hundred superintendents did not answer either the first or third questions, most of them replying that they had not laid such duplicate mains. Three hundred and one answered the question, and of these, 162 were in favor of the duplex main system. Of the 139 who answered the first question with "no," 71 gave a reply to the third question specifying the width beyond which two mains would be justified; from which we conclude that their negative reply to the first question meant that they did not prefer it in their own city, where possibly the streets were all narrow, but would think it desirable in other cities with wider streets.

Most of the advocates of this system do not recommend it for all streets, but some of the replies to our questionnaire went even further than they do, seven of them favoring it for all streets which are paved. Six others stated that it depended upon the kind of pavement, presumably meaning that where a so-called permanent pavement was laid it might be desirable, although not desirable in the

case of macadam, gravel, and similar road surfaces. Two condition their approval on the existence of a parked space on each side of the street, in which to lay the pipe. Three stated that they would use them in streets containing street car tracks, regardless of the width. Three advocated them for streets of busy traffic, presumably because of the undesirability of interfering with such traffic by excavating for house connections. Several stated that it was not so much a matter of the width of the street as of the length and number of services, spacing of houses, etc.; in other words, the relative cost of the one-main and two-main systems. One recommended it for eliminating electrolysis, probably because by placing the mains on the sides of the street they were further removed from the car tracks from which the current reached the pipe.

Of the total number replying, 78, or 26%, had already laid duplex mains on some streets.

Replies to the third question, as to the width of street which would justify the laying of two mains, are not as informative as could be desired for the reason that a number of our informants undoubtedly used the word "street" to designate the width between curbs rather than between property lines. This meaning must undoubtedly have been in the minds of those who gave the width as 26 ft., 30 ft., 36 ft., 40 ft., etc. Several stated that the width referred to the roadway. On the other hand, those who gave as the limit 200 ft., 150 ft., 125 ft., etc., presumably referred to the width between property lines. More of the replies, however, lay between 75 ft. and 100 ft. than any other width, and here the intent might have been to refer to either the roadway or the total width. Of the 41 which specified 60 feet as the minimum width, several specified that they referred to the roadway, and probably all of the 60 foot widths were so intended.

Undoubtedly all of those below 60 feet referred to the roadway only. The numbers designating each of these widths were as follows: 60 feet—41; 50 feet—19; 45 feet—2; 40 feet—14; 35 feet—1; 30 feet—5; 25 feet—1. Fourteen specified 70 feet, 8 specified 75 feet, 29 specified 80 feet, 2 specified 90 feet, and 46 specified 100 feet. Only a few indicated over 100 feet, 3 of these indicating 115 feet, 3 of them 120 feet, 4 of them 125 feet, 5 of them 150 feet, one 160 feet and one 200 feet.

While many of these figures are uncertain as to meaning for the reason already stated, they indicate that at least 63 superintendents did not think the two-main system was justified for streets less than 100 feet wide between property lines, while 83 considered it would be justified where roadways were 60 feet or less in width. And 77 per cent considered this system would be desirable under some conditions.

Taunton Water Works Items

The Water Commissioners of Taunton, Massachusetts, in their annual report for 1927, state that, in continuing their policy of replacing all small mains with pipe of larger size, they obtained in March a council appropriation of $90,000 and on April 1 let a contract to the U. S. Cast Iron Pipe & Foundry Company, the lowest bidder, for De Lavaud centrifugally cast cement-lined pipe, of which about 6½ miles was laid. An Ingersoll-Rand air compressor was purchased in May and was used to great advantage nearly every day for more than four months in connection with this work.

Learning that the price of cast iron pipe was lower than it had been for several years, the board requested the council for another appropriation of $90,000, which was made in October, bids were received for cast iron pipe, at which a price about 30% less than the April prices was received, the U. S. Cast Iron Pipe & Foundry Company again being the lowest bidder.

Red Brass Services. Many requests were received from consumers for cleaning service pipes to give a larger supply of water, the trouble with service pipes apparently being on the increase. Some of this appears to be caused by galvanic action between the different metals used. This condition led to the consideration of the advantages of red brass for service pipe. Tests having shown that red brass alloy is less subject to corrosion and chemical action than any metal suitable for service pipe, on April 25 red brass was adopted for all services and its use began on the first of July.

The use of a gooseneck for connection at the mains was discontinued and a rigid connection is made. The entire service, including shut-offs and fittings, is now of the same composition from the main in the street into the building. "While the use of this pipe will ultimately lessen the demand for the cleaning of services, it will be years before the effect is noticeable. Meanwhile it will be necessary to detail three men solely to this work during most of the summer. Customers desiring to use water freely can not be asked or expected to wait three or four weeks for service, as they have been obliged to wait at times in the past few years, while the department tries to carry on this work as men can be taken from other important work. The department must render better service, and maintenance appropriations are required sufficient to enable the proper service to be given."

Water Works Improvements Lower Fire Rates

When the city of Dubuque, Iowa, changed from the old alderman form of government to the city manager form, the new administration found the city water works to be greatly in need of many improvements. Pumping stations were old and not fireproof; the equipment was worn and becoming obsolete; water supply was low and storage reservoirs were uncovered.

A short while after the new form of government had been inaugurated, it called for a survey by the National Board of Fire Underwriters of the city water works and the city fire department. This resulted in recommendations of a great many improvements and changes in both departments. At the same time the board agreed with the city council that after the improvements were made fire insurance rates would be lowered from the very high class in which Dubuque had been placed.

The improvements were made and J. W. McEvoy, Superintendent of the department, states that the citizens of Dubuque are enjoying a saving of $50,000 per year in fire insurance rates. The most im-

portant of the improvements described by him are a seven and a half million gallon reservoir costing $36,500; a new fire-proof pumping station costing $34,704; new fire-proof booster station costing $10,215; new electric-driven equipment for both of them costing, for the former, $115,444 and for the latter, $16,407; recasing and relining a 600,000 gallon reservoir and erecting a 600,000 gallon stand-pipe, costing $10,000 and $17,333 respectively. The total cost of the improvement was $631,039.

However, only $375,000 in bonds were sold to cover the cost of these improvements and extensions, the difference being paid out of the earnings of the department. Moreover, a sinking fund has been established by which both the interest and principal of the bonds will be paid, so that it will not cost the tax payers anything for the improvements and saves about $50,000 a year in fire insurance rates. (The cost of the improvements will, of course, be paid for by the consumers in their water rates. Editor.)

Time Savers in Water Analysis*

Routine practice in the Chemical Laboratory of the Pennsylvania Department of Health. Comparators, burettes, tubes and dishes kept in definite places and used for assigned purposes only. Ten samples run in a half day

By Major F. E. Daniels

STARTING THE WORK IN THE MORNING

At 9:00 A. M. the chemist arrives, and immediately turns on the water bath, takes out the dish for solids and nitrate dish which have been in the electric oven over night, the water from which has evaporated and the solids dried. The solids dish is put in the desiccator to cool and the nitrate dish removed to the work table.

All tubes, flasks and dishes, which are handled in sets in frames or racks, are now removed from the drawers or lockers under the work table and placed on the table. The rolling table holding the sample or samples is pulled over nearby, and into the tubes, flasks or dishes the proper amounts for tests from the corresponding samples are placed. All measuring apparatus, such as pipettes and burettes, as well as all other utensils, are kept in definite places and are set aside for definite purposes and under no circumstances whatever are any of them borrowed for any other use.

As to the exact order of the tests, personal preference may dictate provided the order is such that no time is lost and that the longer operations are started so that shorter ones may be done while digestion, cooling or distillation is going on.

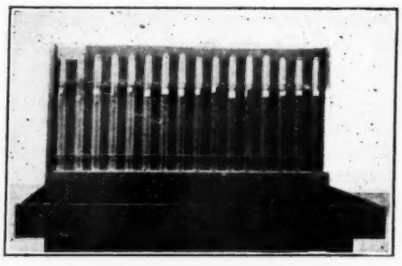
*Continued from page 215

THE AMMONIAS

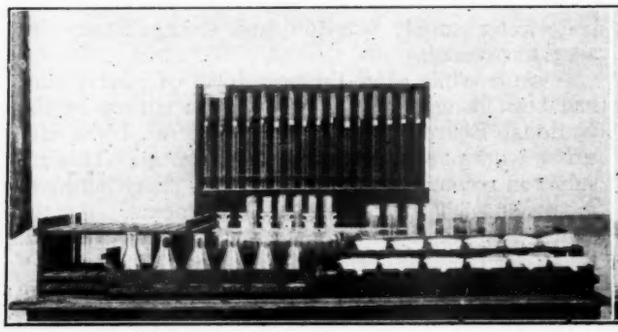
The ammonia stills are always boiled out after each tests and thus kept free and ready to use.

The free and albuminoid ammonias are distilled off as usual, the distillates being taken off in Nessler tubes and placed in a rack and nesslerized immediately, thus showing the number of tubes necessary to be distilled over.

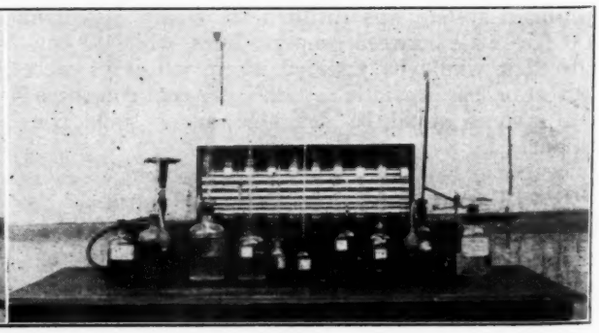
The rack is 16 by 16 and 7 inches high and has 100 seven-eighths-inch holes in ten columns of ten holes each, and a yellow line across the rack between the 5th and 6th holes. The tubes from each sample are placed in the respective columns, the free ammonias beginning at the back and coming forward and the albuminoids beginning at the yellow line. Thus this rack accommodates the tubes from 10 samples at a time. The tubes are rapidly nesslerized by the nessler solution



AMMONIA COMPARATOR



NESSLER TUBE RACK, OXYGEN CONSUMED RACK, HARDNESS RACK, NITRATE RACK, ALKALINITY RACK, CHLORIDE RACK, NITRATE RACK AND AMMONIA COMPARATOR



TURBIDITY COMPARATOR, SPECIAL BURETTES, SPECIAL PIPETTES OF REAGENTS, AND MEEKER BURNER WITH SUPPORT

being dropped into each tube by removing the finger from the top of a piece of glass tubing in the stopper of the bottle. After all the tubes have been nesslerized they are ready to be read when conveninet. The reading is done by comparing each tube with permanent standards held in a comparison rack and spaced so that the unknown may be placed between a pair of consecutive standards. Reflected light from a piece of milk glass illuminates the tubes and the standards are each sealed with a glass disc, thus avoiding stoppers and evaporation. The comparator is backed up with thin wood painted black and stands out of the way covered with a cloth cover when not in use.

CHLORIDES

Chlorides are titrated in casseroles which are handled in a rack moved along under the automatic burette. This automatic burette holds the standard silver nitrate solution and is made from two glass stopcocks, a graduated 10 cc pipette and a laboratory 500 cc bottle. The whole apparatus is painted an amber color with dark varnish, and is much like a Squibb's burette. This burette is a time saver.

NITRATES

The nitrates are done in the usual manner by the phenol disulphonic acid method. The porcelain dish containing the residue from 25 cc of sample is treated with the phenol disulphonic acid. This is added by means of a combination of pipette and glass stopper made and ground into the bottle in the laboratory. This avoids the washing of a pipette each time, provides a place for the pipette and does away with the loose glass stopper. The dishes are washed into low form 100 cc Nessler tubes, made alkaline and compared with permanent standards in tubes, sealed with glass discs and kept in the back row of the rack.

NITRITES

The nitrites are done in 50 cc tubes held in a rack with a set of permanent standards in similar tubes in the back.

The alpha-napthylamine and sulphanilic acid are added by means of 10 cc pipettes kept in the stoppers of the bottles, one cc of each solution being dispensed into each tube with a single filling of each pipette.

TOTAL HARDNESS

The total hardness is determined by the soap method and the soap solution is added from a special automatic burette similar to the silver nitrate burette and the 8-ounce shaking bottles are handled in a rack.

ALKALINITY

The alkalinities are done in casseroles handled in a rack, the test being made by titrating with N/50 sulphuric acid from an automatic burette using brom-phenol-blue as indicator. This is much simpler and quicker than the erythrosine method and gives the same result.

COLOR

Colors are compared in 50 cc Nessler tubes with color standards held in a rack comparator similar to that for the ammonias.

ODOR

Odor is determined on the sample in the sample bottles after about half has been taken out. The bottles are violently shaken and then smelled.

TURBIDITY

Turbidity is determined in low form 100 cc Nessler tubes placed between similar tubes containing silica standards held in a rack with a black and white striped back-ground. The rack is violently shaken, which shakes up all the standards at once and then the unknown sample is quickly compared. The rack is valuable, as any standard which has gone bad is quickly detected. Turbidity standards frequently go bad and are likely to escape detection if only one standard is used at a time.

HYDROGEN-ION

The pH is determined by the colorimetric method, using 4 cc. in 100 mm. by 13 mm. tubes and adding 2/10 cc of the indicator. Comparison is made against standards in tubes of the same size.

SOLIDS

The solids are determined by weighing the cooled dish from the evaporation of the night before. The weighing is done as described in weighing the empty dish, the figures on the card giving an indication of approximate weight.

The dishes are then ignited over a meeker burner, cooled and weighed again thus giving the volatile solids and the fixed residue. The arrangement on the cards facilitates the computation.

A brass shade holder, used to clamp on an electric light socket to hold a glass shade, clamps on a larger meeker burner and forms a convenient support for a nichrome triangle to hold the silica dishes for ignition.

IRON

The iron is determined upon the fixed residue in the solids dish, the dissolved iron being transferred into low form 100 cc Nessler tubes held in a rack with permanent iron standards in the same size tubes held in the back row of the rack. After the dishes are cleaned up they are ignited and stored in the desiccator beside the balance.

OXYGEN CONSUMED

This determination is done for the purpose of collecting these figures on the Pennsylvania waters, as we had no chemical analyses before our laboratory was started.

The test is the standard 30 minute digestion test at boiling temperature. From each sample 100 cc. of water is placed in Erlenmeyer flasks, held in a rack, 10 cc. of sulphuric acid is run into each flask from an automatic burette graduated in 10 cc volumes. Then when the water bath is hot, 10 cc of potassium permanganate solution is run in from an automatic 50 cc burette in the flask and put into the water bath, the exact time being noted on a laboratory timing clock. Each flask is treated in the same manner at half-minute intervals. The clock is then set to ring in 29 minutes which gives the chemist a minute to get ready after the bell rings. When this happens, at half minute intervals, the flasks are removed one by one and 10 cc ammonium oxalate solution run in from an automatic 50 cc burette until all are out, after which each one is titrated with permanganate, and the calculations made as per standard methods by correcting for the blank.

ADDITIONAL FEATURES

Additional points of interest in the test are: slotted board covers to hold the necks of the flasks in the bath and keep in the steam, and the clamps

for holding the rings together for facilitating uncovering and covering the holes in the water bath. The board covers are of ½-inch poplar 7 inches by 7 inches with an 1⅛-inch hole bored in the center to fit the neck of the flask under the flange. The hole is slotted out to one end to slip on the flask under the flange, and a block on the board serves as a handle by which to lift the board and flask in placing the flask into and removing it from the bath.

The clamp consists of a strip of metal with a hole in the center which is put over the screw taken from a dry battery and soldered to the under side of the center cap of the loose rings of the water bath. By screwing up the nut which comes on the battery screw, the cross bar clamps the central cap and all the rings of that hole securely together. This is a very great convenience and should be put on by the makers of water baths, as it can be taken apart instantly for other purposes, while in the clamped position the cover is solid and fishing in the hot water for parts that have fallen through is avoided.

It is furthermore emphasized that just as soon as a set of determinations is made, that set of apparatus is cleaned up and put away, thus reducing the amount of utensils on the table, as all sets are usually filled up at the start. Nitrites are started early in order to develop color and ammonias, and solids are worked along with other determinations.

Just as soon as the analyses are finished, the cards are signed and dated by the chemist. These and the accompanying descriptive slips go immediately to the stenographer, who transfers the information from descriptive slip and analysis card to the report sheet, making as many carbon copies as desired at the same time. The chemist then checks and signs the reports. The original is sent to the main office for filing, the first carbon copy is placed in a stamped and addressed envelope and mailed to the district engineer, and the third copy is filed in the laboratory. A supply of envelopes is kept on hand with postage stamps affixed and the names and addresses of the district engineers stamped on with a rubber stamp. In this way reports of samples leave town within 24 hours after the samples are received unless a Sunday or holiday intervenes.

REPORT OF CHEMICAL ANALYSIS

Lab. No.	Harrisburg, Pa. .....
Sample of	Date of Collection .....
Municipality	Premises .....
Tenant	Owner .....
Collected by	Weather Condition .....
Source of Sample	.....
.....	.....
Kind of Supply	Date Examined .....

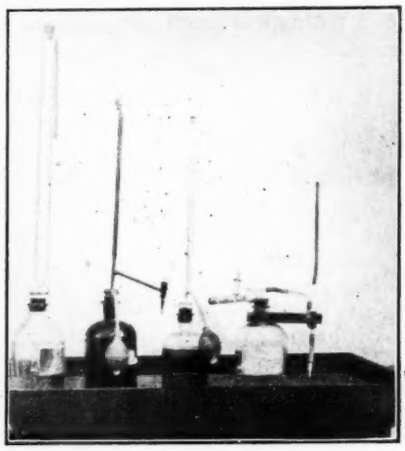
CHEMICAL RESULTS EXPRESSED IN PARTS PER MILLION

Color	Nitrite Nitrogen .....
Odor	Nitrate Nitrogen .....
Turbidity	Chloride .....
Total Residue (103° C)....	Oxygen Consumed—(30 min.
Volatile Matter	100° C) .....
Fixed Residue	Alkalinity .....
Suspended Matter	Total Hardness (Soap)...
Ammonia Nitrogen	Total Iron .....
Albuminoid Nitrogen	Dissolved Iron .....
Organic Nitrogen	Carbon Dioxide .....
pH	Dissolved Oxygen..% Sat..
Chemist	Approved .....

No interpretation is placed on the report, because the bacterial analyses are done in Philadelphia and the inspection reports are not received at this office but go to the district engineer, who must make the interpretation.

By our system of handling, breakage is reduced to a minimum, and by having the stills the right height a Nessler tube is rarely ever broken. Whenever a piece of apparatus is broken, if it can be repaired or a part salvaged, it is put in a drawer and repaired later, or some useful apparatus made from the parts. The glassblowing lamp is used a great deal. No one is allowed to work with a broken piece of apparatus nor is the borrowing for other purposes of apparatus set aside for tests permitted under any circumstances.

In addition to the desiccator and counter weights already mentioned, the writer designed and personally constructed all the comparators, racks, automatic burettes and special pipettes and developed the forms and special time-saving methods of manipulation and routine, except two standard 50 cc automatic burettes. The ammonia comparator was designed after a similiar one in another laboratory. A special automatic burette was also built for free



SPECIAL AUTOMATIC BURETTES FOR SULPHURIC ACID, SILVER NITRATE, SOAP SOLUTION AND CO^2 TESTS

CO_2 which is occasionally determined on waters.

It is hoped the ideas presented will be useful to other workers, as our daily routine performance seems utterly inconceivable to many laboratory chemists. The samples may be run in sets of 6 or 10 as preferred or as the amount of work demands. One person can regularly run 10 samples in the forenoon and, if necessary, 10 in the afternoon, although the latter leaves no time to keep up solutions; but 10 a day is easy going.

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Sewage Plant Operation

It is encouraging to learn, as stated elsewhere in this issue, that the Ohio Department of Health finds the municipalities of that state "beginning to realize the necessity for skilled operation and supervision of the [sewage treatment] plant, which can only be obtained by properly educated men." That it is only a beginning is indicated by the statement in the same connection that "probably less than 10 per cent of the plants have been operated under technical supervision and probably less than 20 per cent have been giving satisfactory service to protect the streams from nuisance and undue pollution conditions." How a state sewer rental law has aided to improve this condition during the past four years is described in the article referred to. Twenty-two municipalities have adopted or are considering establishing sewer rentals, the proceeds to be devoted to maintaining and operating their sewage plants and sewers.

Operation of sewage plants is similarly unsatisfactory in most of the states, and they might well try a plan similar to Ohio's as a step toward remedying the situation.

Importance of Road Maintenance

From time to time criticisms appear in print (not in technical or highway papers, however) of the increasing cost of maintaining roads as compared to that of building them. The majority of the critics base their criticism chiefly on the assumption that the roads must have been poorly built or they would not need repairs.

It is unnecessary to tell those really informed in highway matters that as mileage of new roads increases, the expenditures for maintenance demand an increasing percentage of the annual allotment for highways. If the average annual cost of maintenance of a road is five percent of the construction cost and the annual expenditure for roads remains constant, in fifteen years more than half of it must be used for maintenance. Add to this the expenditures for maintaining in passable condition, roads not yet improved, and the time may be shortened. In twenty years it will take more than a billion dollars a year to maintain our roads, unless the rate of construction falls off enormously.

Highway conditions in France may give us an idea of what to expect. The government budget for 1928 for highways totals 566,515,000 francs, of which 475,500,000 is "maintenance and ordinary repairs," 51,000,000 for repairs necessitated by the war and special cases, and only 8,000,000 francs for "construction and improvement." Only 1.4 percent of the appropriation is for construction and more than 94 is for maintenance.

(It may be interesting to note, in this connection, that France last year raised 619,870,000 francs by taxes on automobile and 891,940,000 by gasoline tax; a total more than 2½ times the total highway appropriation. The rest went into the general treasury.)

As maintenance is absorbing more and more of our highway expenditures it should receive a larger share of attention by engineers, superintendents and other highway officials. The important question is becoming, not "what is the best pavement to use?"

but "what is the best way of keeping in condition the pavements we have?"

The past ten years have seen great progress in the development of equipment for replacing labor, lowering cost and increasing speed of construction. Much of this equipment is useful for maintenance also, but there is wide opportunity for development of mechanical aids to maintenance, and undoubtedly such development will follow rapidly on the demand for it. (As told elsewhere, Pennsylvania has more than $4,000,000 invested in maintenance equipment).

On another page we give a synopsis of the methods and equipment used by hundreds of counties in maintaining their roads, and illustrations of some of the equipment available. In reading between the lines of the reports from these counties it seemed to us that many of them are not taking seriously the problem of maintenance—they look on it as side issue, with construction as the main one. Unless serious attention to maintenance begins immediately on the completion of construction, we are wasting a large part of the hundreds of millions we are putting yearly into constructing improved highways.

Qualification of Contractors in New Jersey

On April 4, Governor Moore of New Jersey approved Assembly Bill No. 219 which grants permission to "any officer, board, commission, committee or department, or other branch of state government," to require the filing of a questionnaire on the part of any contractor who desires to bid on public work and to reject bids received from those not qualifying. The act goes into effect immediately.

This act permits the requiring of any bidder of "a standard form of questionnaire and financial statement containing a complete statement of the person's financial ability and experience in performing public work, before furnishing such person with plans and specifications for the proposed public work advertised."

Force Account on Public Works

Methods of paying for force account work in thirty-one cities—Percentage, items covered, equipment rental, limiting amount of extra work, monthly payments—All to be provided for in the contract.

An interesting report discussing the prevailing practices in relation to force-account work performed in connection with contracts for public work, has recently been published by the Bureau of Municipal Research of Philadelphia as agent for the Thomas Skelton Harrison Foundation. This is primarily a study of the practices in Philadelphia and a comparison of them with the practices of other cities, and recommendations of changes in the Philadelphia practices. However, the information obtained and the recommendations made are of interest to all cities. The report is the work of Philip A. Beatty, civil engineer, of the Bureau's staff.

At the outset of the study, the attention of the Bureau was attracted by what seemed to be the very unusual practice in the Department of City Transit in Philadelphia, of fixing the percentage on force account by bidding. This practice was not found to exist in any other city whose specifications were studied.

Another thing shown by the report which attracted attention was the great diversity in specifications governing the municipal public work in the different cities. "It would seem that greater uniformity could be achieved and would be beneficial. When specifications differ in different cities, or the absence of express provision in specifications leaves room for diversity of practice or uncertainty of practice, free bidding by contractors, especially by out-of-town contractors, is discouraged. Contractors may misinterpret specifications or be surprised during the progress of the work by practices which do not conform to those with which they have had experience. We believe that standardization of public works specifications in American cities would benefit the cities as well as the contractors." The Bureau expresses the hope that this study may contribute something towards such standardization.

In carrying on the study, the bureau examined specifications of public authorities of a considerable number of cities. Many of these made no provisions for force-account work, but those of Philadelphia and thirty others did.

The study concerns itself with extra work by force account; extra work being defined as that of a kind for which unit prices have been bid but in excess of the quantity which the contractor is obliged to do at unit prices; or work of a kind for which no provision at all has been made in the schedule.

"There are several methods by which the contract may provide for payment for extra work. These are: 1—At the unit prices bid by the contractor. 2—At fixed prices stated in the specification. 3—Under a special unit-price agreement between the contracting parties. 4—With a lump sum, agreed upon between the engineer and the contractor. 5—By force account, on a cost-plus-a-percentage basis. 6—At cost plus a fixed sum."

The first the Bureau considers to be the best if practicable and just, but if the extra work were more difficult or expensive to perform than the work upon which the unit prices were bid, adherence to the unit prices might work a hardship on the contractor. Thus, additional excavation might be at a depth so much greater than the unit-price yardage that the unit price would not be a fair compensation for it.

The second method gives the contractor no choice concerning the payment and is open to the objection that, if the fixed prices are lower than the price for which the contractor thinks he can do the work,

he must be willing to accept a loss, refuse to bid, or add something to another item to make up for the shortage. As the specifications give only the fixed prices for the work and not the quantities, a definite conclusion as to the additional costs can not be reached by the contractor and he must add what he hopes will be enough to cover them. On the other hand, if he considers the fixed prices high enough to yield a good profit, he is debarred from reflecting this thought in his estimate, because it may happen that no extra work will be done under these prices.

The third method has much to recommend it, but the contractor is usually better equipped than the engineer for such bargaining, since he is in daily touch with costs while the engineer has them only at second hand.

The fourth method is not felt to have any special advantages.

The fifth method is that discussed in this report.

The sixth method is similar to the fifth but with the idea of removing any incentive to increase the cost of the work which may exist, by making the sum received in excess of the cost independent of the cost. This is more commonly used on large and independent pieces of work than on extra work in connection with other contracts. For the latter class of work it presents the objection that the contractor, not knowing the extent of the amount of extra work which he must assume, finds it difficult to decide beforehand on a fixed sum as compensation.

Fixing the Percentage. The Department of City Transit of Philadelphia has adopted the practice of having the contractor bid the percentage which he would receive on extra work. This practice is considered inadvisable because it opens the way for an unbalanced bid. A contractor having special familiarity with local conditions might be enabled to foresee that more force-account work would be required than was estimated by the city's engineers, and by bidding a high percentage on force account and a low unit price on another item would thus keep down his bid as compared with other bids, but might make a neat profit on the increased expenditure for force account. The practice would tend to place out-of-town contractors at a disadvantage because the local contractors, having superior knowledge of the conditions, would be able to approximate more closely the actual amount of force-account work needed.

Items on Which Percentage Is Allowed. All of the thirty specifications examined provide for paying the percentage on labor. On materials, 26 pay a percentage, while 4 pay the cost only. On plant rental, 6 pay a percentage, 12 pay rental without percentage, 6 pay no rental but include the plant costs in percentage, 6 do not refer to the subject. In the case of insurance on labor, a percentage is paid by 7, 11 pay the insurance cost only, in 8 the insurance is included in the percentage, and 4 do not refer to it.

What the Percentage Pays For. The specifications usually name some or all of the items which the percentage is supposed to cover. Those of the Baltimore City Water Department state that the percentage is based on actual cost, which does "not include the use of tools or general superintendence, or office accounting or engineering expenses, or any allowance or percentage for collateral or estimated costs, or any profits," all of which is deemed to be included in the specified 15%. In other cities it is specified to cover "supervision, overhead, insurance, profits, etc."; "administration, general superintendence, profit and all other expenses not included in the net cost"; "interest, rent, depreciation of plant, service of general superintendent or administrative force"; "administration and clerical expenses, supervision and superintendence above foreman, cost, use or upkeep of tools, plant and the machinery and rent of storage yard."

A contracting company reported that in its opinion "compensation insurance should be included as a part of the cost, as it can almost be regarded as a part of the labor charge." This insurance ranges from 2% up to nearly 9%, and this might almost of itself absorb the percentage allowed on labor cost unless included as one of the items paid for. Another similar item is that of the premium on the surety bond.

What Percentage. As to the percentage to be paid, this seems to vary between ten and twenty per cent. One prominent contractor stated that on small contracts "15% is a fair allowance, but on large contracts where there is a likelihood of considerable extra work being done, 10% should be sufficient." A Baltimore engineer said that most contractors claim that 15% is too small for overhead and supervision, while others seem to be entirely satisfied with it.

Rental of Plant and Equipment. The report states that it simplifies bookkeeping to include machine operators and drivers in the hourly rental price and also it appears best to include a profit; hence, to allow a percentage on the rental price would be a doubling of profits.

Specifications providing for a separate rental agreement, where there is a large amount of equipment used, have the advantage of removing from the minds of both the contractor and the field engineer the question of just how much the former will be required to furnish for the percentage.

Repairs to the Plant. Some specifications allow these and others include it in the percentage paid. If repairs are allowed, there is an opportunity for an unscrupulous contractor to charge for repairs properly chargeable to other jobs. If repairs are not allowed for separately, the contractor would properly add something to plant rentals to cover breakage or damage incurred exclusively on this work.

In the matter of the furnishing of materials by the municipality, the report states that it seems desirable for the city to reserve the right to furnish materials. Whether a percentage should be allowed on them when furnished by the contractor should perhaps be considered an open question.

Part of Contract. The specification should make it clear that extra work, including force account, is an integral part of the job covered by the contract and subject to all the conditions thereof.

Limiting Amount. It was thought that there should be in the contract a limit to the amount of force-account work. The New York City Board of Transportation limits the total amount to 2% of the total contract price. Under the Gilboa dam contract, the Board of Water Supply could not spend more than 5% of the contract price on force-

account work; and in New Orleans it is restricted on paving contracts to $500. None of the other cities whose specifications were studied make any such restrictions.

Daily Time Sheets. It was recommended that it be required of the contractor that he file each day with the engineer a daily time sheet, giving the amount of labor employed on extra work during that day; also that this time sheet be signed by the time-keeper representing the contractor and the inspector representing the engineer. It was recommended that the contractor's bills for force-account work be rendered monthly in order that any dispute concerning items might be settled promptly while they are fresh in the minds of both parties.

Extension of Time. It was thought proper that a clause providing for the extension of the contract time by an amount equivalent to any delay unavoidably incurred by doing extra work, should be included in the contract.

The following is the summary of conclusions and recommendations of the Bureau, omitting such sentences as refer purely to the Philadelphia conditions and recommendations.

1. The specifications should be truly specific and should be standardized as far as practicable. Every point which, so far as can be foreseen, may raise a question between the contractor and the engineer during performance of the contract, or in the mind of the contractor at the time of making his proposal, should be covered in the specifications. Standardization of specifications—that is, uniformity with other cities—is, of course, not a matter solely wthin the city's control However, officials should take advantage of every opportunity to promote uniform specifications. Completeness and uniformity of specifications should encourage bidding, especially by out-of-town contractors. by reducing the necessity of guarding against surprises which may otherwise be encountered during the course of the work.
2. Extra work probably cannot be avoided on major construction, and provision should be made for it in the specifications.
3. A schedule of fixed prices for extra work is of doubtful utility for the reason that if the kind, quantity and cost of the work (all of which must be known in order to fix prices intelligently) can be foreseen, it would be better to provide for the extra work in the schedule of items and unit prices; and if they cannot be foreseen, any figures prepared by the engineers must be guesswork, which is contrary to the whole theory and intent of the specifications.
4. It would seem best to use force account only where other methods of paying for extra work are impracticable. Other methods should, therefore, be provided for in the specifications; but force account should also be provided for in the event that the other methods are found impracticable.
5. The percentage to be allowed on force-account work should be fixed at a reasonable rate stated in the specifications.
6. The items on which the percentage is allowed and the items for which the percentage is meant to compensate the contractor should be stated in the specifications.
7. The specifications should provide for the rental of plant, equipment, and power tools at prices to be agreed upon in writing, and should state how plant repairs are to be taken care of. No percentage should be allowed on rental.
8. Extra work should be expressly made a part of the contract, subject to all the conditions of it, especially those referring to insurance, and the fixing of responsibility for accident.
9. On large contracts the amount which can be spent on extra work should be limited to some percentage of the contract price and a sum should be set beyond which payment for extra work cannot be made without additional authorization.
10. It may be desirable at times for the city to furnish materials for construction. The specifications should therefore reserve this right. On the question whether the contractor should be allowed a percentage on the cost of materials furnished by the city no recommendation is made.
11. Except for work done in emergencies, claims for force-account work should not be valid unless based on written orders, and costs should be agreed upon in writing before work is begun.
12. Specifications should provide for daily checking of time sheets by representatives of the contractor and the engineer and for the filing of the sheets in their respective offices.
13. Payments for extra work should be made monthly and should be based on monthly statements made by the contractor.
14. Specifications should give the contractor the right to an extension of time for the completion of a contract delayed by the necessity of doing extra work.

This report of thirty pages will be furnished to anyone upon request to the Bureau of Municipal Research, 311 South Juniper Street, Philadelphia.

Improvements for New Subdivisions

At the session on June 7 of the annual meeting of the New York State Conference of Mayors and Other Municipal Officials, Philip H. Cornick of New York declared that cities are becoming tired of putting up the money for some individuals to gamble with, the cities standing all the losses when the venture fails. "If lots are sold to buyers who proceed to erect houses, the assessments will probably be paid and the city will recover its own investment in the subdivision. If the lots are sold to speculators, on the other hand, there is more than a fair chance that many if not all of the special assessments will become delinquent. In that case the general taxpayers may be called upon to pay for a useless set of streets, sidewalks, sewers, and water mains. In either case, the promoter has frequently taken a profit on the city's investment, possibly without having risked much money of his own.

"Several cities of the country are trying to find some means of making the promoters of new subdivisions carry their own risk, by compelling them tc provide the necessary local improvements at their own expense before they place the lots on sale."

Speaking along somewhat similar lines, at the same meeting, Robert Whitten urged every city to make plans for the expansion of its residential areas, warning officials against the tendency toward over-expansion in subdividing land and the economic loss arising from the premature or misplaced subdivision. This, he said, "could very largely he checked if the subdivider were required to lay sewers and water mains and to grade and pave the streets.

"Much of the present financial burdens imposed on the owner of a single family home is the result of unwise methods of controlling the subdivision of land into building lots, the character of street improvements required by the city standards and the increase in land values with attendent higher carrying charges and higher taxes. If we are to retain the single family home as a predominant type of housing in American cities, we must find ways to reduce the financial burdens of the home owners."

Recent Legal Decisions

ABUTTING OWNER REPAIRING SIDEWALK UNDER DIRECTION OF CITY AN EMPLOYEE UNDER WORKMEN'S COMPENSATION ACT

The owner of a house was directed by the municipality to fix up the sidewalk in front of his house, which had become out of repair by the fall of a tree, and to send a bill to the city, which it would pay. In the course of the work, which the owner did himself, he injured his right hand. The Connecticut Supreme Court holds, Morganelli's Estate v. City of Derby, 135 Atl. 911, that the owner was an employee of the city, and not an independent contractor, and was entitled to compensation under the Workmen's Compensation Act.

DAMAGE FOR DELAY IN COMPLETING ROAD CONTRACT

Where a road contractor has also contracted with the county to build the culverts on the road, he cannot excuse his delay in completing the road by the county's failure to build the culverts. A county which is obliged to keep engineers on the job after the time limited for completion of a road is entitled to recover from the contractor the cost of this service. If the county is not guilty of delaying the work it may recover the liquidated per diem damages for delay provided for in the contract. Maryland Casualty Co. v. Ballard County, Kentucky Court of Appeals, 289 S. W. 316.

RIGHT RESERVED TO CANCEL CONSTRUCTION CONTRACT FOR DELAY

Although a contract reserving the absolute right in one of the parties to terminate it at any time could not be enforced because lacking in mutuality, a sewer construction contract authorizing the city through its engineer to cancel it if " the work is not being pushed as it should be", that being left to the engineer, was not lacking in mutuality. The engineer, however, could not arbitrarily or capriciously exercise his judgment, but must have acted in good faith and on reasonable grounds. City of Bowling Green v. Knight, Kentucky Court of Appeals, 288 S. W. 741.

RECOVERY OF COST OF CONSTRUCTING RAILROAD CROSSING FROM RAILROAD

The Arkansas Supreme Court holds, Road Improvement Dist. No. 7 v. St. Louis-San Francisco Ry. Co., 288 S. W. 884, that no notice to a railway company to construct a crossing under Ark. Roads Act 1919, No. 292, §24 is necessary. If the road improvement district is compelled by circumstances to discharge this duty it may recover the cost from the railway company. Its remedy by mandamus to compel the railroad to construct the crossing is not exclusive.

VALIDITY OF RELOCATION OF STATE ROAD AROUND CITY

The Illinois Supreme Court says, MacGregor v. Miller, 324 Ill. 113, that the word "road" is now commonly used as denoting a public way in the country, rather than the street of a town or city, and the most natural construction of section 7 of the Illinois $60,000,000 Bond Issue Act of 1917, providing that old bridges forming part of existing roads should, when in proper condition, be used in the new system, would be to confine it to bridges in roads outside of the limits of cities, villages, or incorporated towns.

Where the route of a new road is a part of a state-wide system, the primary interest to be considered is held to be that of the state at large and not of the particular locality in which the road is built. The only right given by the Illinois Bond Issue Act of 1925 to such a locality is the right of reasonable connection with the other cities located upon the route.

A proposed expenditure of $250,000 by the state department of public works and buildings on the relocation of a state road through the outskirts of a city was held not unauthorized or arbitrary, but within the power of the department to make, where it would result in the elimination of two railroad grade crossings and inconvenient right angle turns in the business part of the city, and the approximate cost of a continuous hard-surface road in improvement of the old route through the city was not shown.

CURB ELEVATIONS AND GRADES SUFFICIENTLY DEFINED BY PAVING ORDINANCE

The Illinois Supreme Court, City of Ottawa v. Smurr, 324 Ill. 61, 154 N. E. 455, holds that a paving ordinance which definitely fixes the elevation of curbs on streets crossed with reference to the city datum, these necessarily fixing the elevation of the curbs on the crossing street being paved, and the elevations of curb at various points along that street, fixes the elevations and grades for all parts of the improvement.

CONTROVERSY BETWEEN ROAD CONTRACTOR AND SUBCONTRACTORS

The Arkansas Supreme Court holds, Philpot v. Shelby, 289 S. W. 781, an action by subcontractors against a road contractor, that a certificate of indebtedness received by a deceased partner of the plaintiffs for the work should be apportioned among the partners on the basis of the sum remaining after payment of the copartnership debts.

The principal contractor could not, in this action, claim damages for defects in the subcontractor's work, no demand having been made on the subcontractor to remedy the defects after his discharge and a settlement made of all matters in controversy.

ROAD CONTRACTOR HELD NOT LIABLE FOR NEGLIGENCE OF INDEPENDENT CONTRACTOR

A road contractor, with the sanction of the county, contracted for the construction of the entire road with subcontractors "as independent contractors." A mail carrier sued the original contractor for damages alleged to result from the impassable condition of the road. There was no proof that the work was inherently dangerous or of any ground for special damage. It was held there was no ground for

recovery against the original contractor, the general rule being that one who is having a piece of work done by an independent contractor is not liable for the latter's negligence. The independent contractors, if liable at all for the bad construction claimed, were not parties to the action. Montgomery v. Garza, Texas Court of Civil Appeals, 200 S. W. 210.

PEREMPTORY MANDAMUS FOR PAYMENT OF ESTIMATE REFUSED

A highway contractor defaulted on his contract with the county, having been paid a sum, being due a sum, the county retaining a percentage, and liens for materials having been filed. The surety undertook the completion under a modified contract for a larger amount, the first contract remaining in force except as modified. The surety had been paid a sum on account and the county refused payment of an estimate although there were sufficient funds in the superintendent's hands to pay it. To a demand for peremptory mandamus to pay this amount the county claimed that it had a right to retain it until all claims and liens had beeen established or dismissed or discharged. It was held, National Surety Co. v. Wallace, 224 N. Y. Supp. 684, that, peremptory mandamus being a drastic remedy, not to be granted unless the right to it is clear, and because of the involvement of property rights, not only of the parties but of persons not parties, the mandamus should not be granted.

BURDEN OF PROVING EXCUSE FOR BREACH OF EXCAVATION CONTRACT

In an action by municipalities against a bridge contractor for breach of contract to excavate to a solid ledge as required by the contract, the Circuit Court of Appeals, Second Circuit, holds, United Const. Co. v. Haverhill, 22 Fed. (2nd) 256, that after the breach had been proved the burden was upon the contractor to establish an excuse. If the contractor, ignoring the terms of the contract, substitutes what he, perhaps correctly, supposes to be everbody's understanding, the court holds that any loss must fall where the words of the contract put it, the court having no choice but to make the written contract the measure of the parties' obligations, although hardship may result.

NEGLIGENCE OF CONTRACTOR FOR INJURY BY TRIPPING OVER LOG MUST BE SHOWN

Where the evidence did not show that a log in the traveled part of a street, over which a pedestrian tripped, belonged to the defendant city contractor doing work at or near the place, or was placed there by the contractor or was in any way connected with him, there was no ground for finding that the injury was caused by the contractor's negligence. Raskin v. John McCourt Co., Massachusetts Supreme Court, 154 N. E. 842.

ASSIGNEE'S ACTION ON DISALLOWED ITEM OF CLAIM AGAINST COUNTY BARRED BY ACCEPTANCE OF ALLOWED ITEMS

After a bridge contractor had accepted two items of his claim against the county, the third item being disallowed, it was held that, under the Indiana statutes, an assignee of the contractor could not sue the county for the disallowed third term.—Parrish v. Board of Comm. of Shelby County, Indiana Appellate Court, 154 N. E. 879. The contractor in this case chose to combine the three items in one claim.

"DEFECTIVE HIGHWAY" UNDER STATUTE—"SUFFICIENT RAILING OR FENCE"

The Connecticut Supreme Court of Errors holds, Horton v. MacDonald, 135 Atl. 442, that a "defective highway" within Conn. Gen. St. 1918, §1414, giving a person injured by a defective road or bridge a right of action, is one "not reasonably safe for travel in view of the purposes for which it is needed and used." Section 1413 gives a right of action for injuries caused by failure to maintain a sufficient railing or fence on a part of a road raised above the adjoining ground so as to be unsafe for travel. A sufficient railing or fence is defined as one adequate under the circumstances to reasonably protect the travel upon the highway.

MUNICIPALITY NOT LIABLE FOR OVERFLOW OF STREAM CAUSED BY CONSTRUCTION OF STREET

The New Jersey Supreme Court, Murray Rubber Co. v. City of Trenton, 135 Atl. 475, holds that the statutes of 1910, 1917 and 1918, as to a municipality's power and duty to keep its gutters, drains and streams open, do not require or authorize a city or county to invade a stream and clean it out or prevent accumulations therein, and a city and county were held not liable for damage by overflow of a stream, caused by the construction of artificial conduits and hard-surfaced streets causing waters to flow through those created channels which otherwise might not have gone into the stream.

HIGHWAY ENGINEERS' CONSTRUCTION OF ROAD CONTRACT FINAL UNDER ITS TERMS

The decision of a highway construction engineer that work done by the contractor constituted a "borrow pit," for the excavation of which he was entitled only to 40 cents per cubic yard, and not a "drainage ditch," for the excavation of which his contract called for $1 per cubic yard, was held final, by the express terms of the contract, which provided that all disputes and misunderstanding between the parties thereto, relative to the construction and meaning of its provisions, and also relative to the performance by either of the parties thereto of the contract, should be referred to the engineer in charge of the work, and that his decision should be final. Lacy v. State, 195 N. C. 284, 141 S. E. 886.

DEVIATION FROM QUARTER SECTION LINE IN CONSTRUCTING HIGHWAY

The Michigan Supreme Court holds, Yeatter v. Myers, 241 Mich. 325, 217 N. W. 57, that a township highway commissioner, laying out a highway along a quarter section line, has discretion, under the Michigan statutes, to angle the highway south from the quarter section line for about 4 rods, then run it parallel with the line for 120 feet, and then angle it back to the line, to avoid a pond hole. Although highway commissioners must adhere substantially to the routes specified in the petition therefor, they may make slight variations to procure a more practicable route.

NEWS OF THE SOCIETIES

July 18-20—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention at Buffalo, N. Y.

Sept. 17-21—NEW ENGLAND WATER WORKS ASS'N. 47th annual convention at Montreal, Canada. F. J. Gifford, Sec'y, Tremont Temple, Boston, Mass.

Sept. 18-20—INTERNATIONAL CITY MANAGERS' ASSOCIATION. Annual convention at Asheville, N. C. John G. Stutz, Lawrence, Kans.

Oct. 3-5—AMERICAN SOCIETY OF CIVIL ENGINEERS. Fall meeting at San Diego, Calif. George T. Seabury, Sec'y, 33 W. 39th St., N. Y. C.

Oct. 13-15—CONFERENCE OF STATE SANITARY ENGINEERS. Annual meeting at Chicago, Ill. Hotel Stevens. A. P. Miller, Sec'y, Butler Bldg., Washington, D. C.

Oct. 15-18—SOUTHWEST WATER WORKS ASS'N. Annual convention at Dallas, Texas. L. A. Quigley, Sec'y, Fort Worth, Texas.

Oct. 15-19 — AMERICAN PUBLIC HEALTH ASS'N. Annual meeting at Chicago, Ill. Homer N. Calver, 370 Seventh Ave., New York City.

Oct. 16-17—NATIONAL MUNICIPAL LEAGUE. Annual meeting at Cincinnati, O. H. W. Dodds, 261 Broadway, New York City.

Oct. 22-26—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention at Detroit, Mich.

AMERICAN WATER WORKS ASSOCIATION

The 48th annual meeting of the American Water Works Association was held at San Francisco, Calif., June 11 to 15, with an attendance of about 600. Business session began June 12. Officers for 1928-29 were selected as follows: President, W. W. Brush, chief engineer, Department of Water Supply, Gas and Electricity, New York City; vice-president, Jack J. Hinman, Jr., Iowa City, Ia.; treasurer, George C. Gensheimer, secretary of the Water Commission, Erie, Pa.; trustees, C. D. Brown, Walkerville, Ont.; S. H. Taylor, New Bedford, Mass.; John Chambers, Louisville, Ky. Beekman C. Little is permanent secretary.

Division officers were elected as follows: Plant Management and Operation, Harry F. Huy, Western New York Water Co., Buffalo, chairman; Water Purification, Prof. W. F. Langelier, chairman; C. C. Hoover, Columbus, O., vice-chairman, and H. E. Jordan, Indianapolis, Ind., secretary. Charles R. Bettis was appointed chairman of the Finance Committee, succeeding Dr. George C. Andrews, who resigned.

The nominating committee also announced nominations for 1929-1930, as follows: President, Jack J. Hinman, Jr., Iowa City, Ia.; vice-president, Geo. H. Fenkell, superintendent and general manager, Board of Water Commissioners, Detroit, Mich.; treasurer, George C. Gensheimer; trustees, J. Walter Ackerman, city manager, Watertown, N. Y.; A. F. Porzelius, superintendent, City Water Co., Chattanooga, Tenn.; W. T. Mayo, Commissioner of Public Utilities, Shreveport, La.

The John M. Diven memorial award, given each year to the active member performing the greatest service to the association, was presented to W. S. Cramer, chief engineer of the Lexington, Ky., Water Co. Mr. Cramer was not present at the convention. The Nicholas S. Hill Cup went to the Florida section which reported an increase in membership of 14 per cent. The California section, however, gained the greatest number of members.

The budget for the coming year was placed at $51,500, which amount included $1,500 for traveling expenses for a committee appointed to work out certain constitutional amendments. The secretary reported a total membership as of June 1 of 2,524, as against 2,403 on January 1, 1927, and 2,442 on Jan. 1, 1928. The Standardization Council was abolished and its work, as well as some new work, will be taken over by a committee. A plan to appoint a technical secretary to serve the technical committees is under consideration. The Southeastern Water and Light Association will become a section of the American Water Works Association. A sewage section, to be known as the California Sewage Works Association, was formed, as mentioned in another column.

More than 60 papers, reports and discussions were listed in the program, and most of these were presented in full. Both papers and discussions were unusually good.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS

The 9th Annual Conference of the International Association of Street Sanitation Officials will be held in Toronto, Canada, King Edward Hotel, Monday and Tuesday, October 8th and 9th, 1928.

AMERICAN ROAD BUILDERS' ASSOCIATION

The American Road Builders' Association has accepted the invitation of the Mexican Federal Highway Commission and Government to participate in the Second National Highway Congress and Exposition to be held in Mexico City on October 3-4-5-6.

The invitation to the Association comes from Mexico after that country has completed its third year of Federal road construction and on the eve of a large highway construction program that will be participated in by all the Mexican states and cities as well as the Federal Government.

Invitations have also been sent to South and Central American countries to take part in this Congress, and it is expected that delegations will be present from all Pan American countries.

One of the first objectives of the Mexican Government is to complete the highway from the United States border to Mexico City, a distance of about 800 miles.

Special freight rates have been obtained for shipping road building machinery to Mexico, and reduced passenger fares will be in force. Several special trains to Mexico City will be run for the benefit of those wishing to visit the country at that time.

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"FROM THE TREE TO THE JOB"

SEVENTH ASPHALT PAVING CONFERENCE

At a recent meeting of the Board of Directors, held in Chicago, New Orleans was chosen as the city in which the Seventh Annual Asphalt Paving Conference, a nationwide convention of asphalt chemists, engineers, producers, distributors, salesmen and contractors, as well as public officials interested in studying the latest methods evolved in constructing street and road pavements, will be held during the week of December 10. New Orleans was selected over a number of other cities, including Havana, Montreal, Detroit, Atlantic City, Philadelphia, Cleveland, Minneapolis, Chicago and West Baden, Ind.

The American Association of Asphalt Paving Technologists and The Asphalt Association, as well as other organizations, will hold their annual meetings in New Orleans in connection with the conference. It is expected that from one thousand to fifteen hundred engineers and Federal, state, county and city road officials, as well as asphalt producers, contractors and machinery manufacturers will attend. The program will consist of discussions extending over a period of several days and will relate to the latest, most effective and most economical methods evolved for the construction of the several types of asphalt paving.

Six national asphalt paving conferences have been held thus far, the first in Atlanta in 1922, the second at Louisville, Ky., in 1923, the third in Denver in 1924, the fourth in Detroit in 1925, the fifth in Washington, D. C.,

in 1926, and the sixth again in Atlanta in 1927.

J. E. Pennybacker, general manager of The Asphalt Association, with headquarters in New York City, is the secretary of the conference. Reduced railroad rates, as for previous conference, will be in effect on all railroads for the New Orleans meeting.

NEW ENGLAND WATER WORKS ASSOCIATION

The 47th annual convention of the New England Water Works Association will be held at Montreal, Can., Sept. 18-21. The headquarters will be at the Hotel Windsor. Officers have been nominated as follows: President, Arthur D. Weston; vice-president, George H. Finneran; directors, Richard H. Ellis and Karl R. Kennison; treasurer, Albert L. Sawyer.

The tentative program is as follows:

Tuesday, September 19.—Morning Session, 10 A. M.; Address of Welcome; Reports of Committees and Officers; Award of Dexter Brackett Memorial Medal. Afternoon Session, 2 P. M.; Technical Papers; Committee Reports.

Wednesday, September 19, Windsor Hall.—Morning Session, 9 A. M.; Technical Papers. Afternoon Session, 2 P. M.; Technical Papers. Evening Session, 8 P. M.; Technical Papers.

Morning, Afternoon and Evening Sessions will be devoted to Superintendents' Conference. These sessions will be in charge of Stephen H. Taylor, Supt., Water Works, New Bedford, Mass.

Thursday, September 20.—Morning Session, 9 A. M.; Visit to Montreal Water Purification Plant. Afternoon Session, 2 P. M.; Technical Papers and demonstration of Televox System by the Westinghouse Co.

Friday, September 21.—Morning Session, 9 A. M.; Technical Papers and Business Session.

CALIFORNIA SEWAGE WORKS ASSOCIATION

The California Sewage Works Association with 49 members was formed at the American Water Works Association meeting held at San Francisco, Calif., June 11-15. The association named an advisory board consisting of C. G. Gillespie, A. K. Warren, Olin Stewart, A. M. Jensen and Philip Schuyler, which board will appoint the necessary committees for organization and functioning. The first regular meeting will be held at San Bernardino, Calif., Oct. 8, in connection with the annual meeting of the California League of Municipalities.

THE AMERICAN WATER METER INSTITUTE

The American Water Meter Institute has been organized, and at a meeting held at the Engineers Club of New York City on May 22nd, officers were elected and committees appointed and definite aims and objects were set forth.

The American Water Meter Institute has been organized by manufacturers of water meters for the purpose of co-operation with customers and all others who are interested in promoting the welfare of the water works industry.

Any manufacturer of water meters whose business is conducted principally in the United States is eligible to membership.

The purposes of this Institute are mainly as follows:

To eliminate practices and methods detrimental to the entire water works industry.

To work for the further acceptance of the present "Standard Specifications", so that the members of the Institute may be protected against unnecessary changes in formulae of materials or changes in design and construction, unless and until such changes are warranted by the progress or the needs of the industry, and to eliminate unreasonable specifications and guarantees.

To promote open discussion of trade conditions and to bring about a clearer understanding of the problems of the manufacturer, vendor and consumer.

To act jointly on such problems as freight rates, exhibits, attendance at conventions, and such other matters as affect the industry.

To promote the use of water meters wherever possible to make a concerted effort to show the public in general and publicly owned water works' officials in particular, that the use of water meters is desirable because it prevents waste of our natural resources, reduces taxes, and promotes public health and welfare.

The Institute will seek definite approval for its work from the Federal Trade Commission.

The officers elected for the ensuing year were: W. F. Rockwell, president; J. B. Kirkpatrick, vice-president; R. S. Bassett, secretary and treasurer.

The following companies, through their executives, have taken membership in the Institute: Badger Meter Manufacturing Co., Buffalo Meter Co., Federal Meter Corp., Gamon Meter Company, Hersey Manufacturing Co., National Meter Co., Neptune Meter Co., Pittsburgh-Equitable Meter Co., Union Water Meter Co., Worthington Pump and Machinery Corp.

AMERICAN ASSOCIATION OF ENGINEERS AND CENTRO NACIONAL DE INGENIEROS OF MEXICO

The American Association of Engineers held its 14th annual convention at El Paso, Tex., June 4 to 6. Simultaneously with this meeting the Centro Nacional de Ingenieros of Mexico held their convention. Mexico City was chosen as the probable 1929 meeting place. The committee report on Services and Fees of Practicing Engineers, prepared by Paul Hansen, of Pearce, Greeley and Hansen, created much interest. The report submitted was in the form of a manuscript for a pamphlet to be published by the Association for the guidance of engineers and those who use the services of engineers, to contain informational data of recognized value on How to Employ and Use Services of Practicing Engineers: 2. Fees and Professional Agreements: 3. Minimum Recommended Fees: 4. Code of Practice. The book will be ready for distribution by September 1st.

The report by Bernard Siems, vice president of the American Waterworks Association, on "Public Improvement and the Tax Rate," created much discussion and was a worthwhile contribution to the convention.

The convention unanimously voted to continue the battle against fake correspondence and trade schools.

Arthur Richards, city plan engineer of Altoona, Pa., in his report on Engineers in Public Works, emphasized the fact that engineers are not getting better compensation because they fail to advertise themselves thus telling the public what the engineer has contributed to its welfare.

WATER WORKS MANUFACTURERS' ASSOCIATION

At the meeting held in San Francisco, Calif., in conjunction with the meeting of the American Water Works Association, the following officers were elected to take office next January: President, R. E. Blanchard, Neptune Meter Co.; vice-president, William E. Sherwood,

KALAMAZOO TRENCHING BRACES

WITH FORGED STEEL SCREWS

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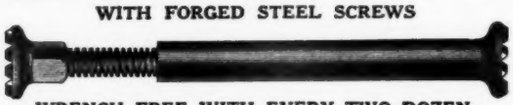

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WRENCH FREE WITH EVERY TWO DOZEN

Not excelled for narrow and medium width trenches. Mud guards desirable where concrete or mud hardens on braces. **The only brace that is free from projections that hinder workmen in the ditch.** Kalamazoo timber brace fittings are suitable for wider trenches.

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Used in Nearly Every State in the Union

SEWER RODS

We will pay freight and ship for trial. Who else will do it?

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133 George St., Boston, Mass.

Hersey Mfg Co.; A. E. Buttenheim and John A. Kienle were re-elected treasurer and secretary, respectively.

CLEVELAND ENGINEERING SOCIETY

G. A. Kositzky has been elected president of the Cleveland Engineering Society and Hugh Cook, vice-president. These, with Theo. H. M. Crampton, Chief Engineer, Servicised Products Corp., and Orrin C. Sabin are trustees. Carlton R. Sabin is Secretary-Manager, and Gilbert O. Ward, librarian.

INSTRUCTION COURSE, PUBLIC HEALTH SERVICE, STREAM POLLUTION STATION

There was held from April 30 to May 12, at the Stream Pollution Investigation Station, Cincinnati, O., a course of instruction for the sanitary engineers of the Public Health Service. Laboratory work in chemical, bacteriological and biological subjects occupied the mornings from 9 to 12, while papers on various subjects were presented afternoons from 1 to 4. Chemical laboratory work included dissolved oxygen determinations, oxygen demand, nitrite and nitrate determinations, free chlorine, chlorides, alkalinity and hardness studies, and the operation and mechanism of chlorinators. The bacteriological studies included the use of Endo media, and the examination of sewage samples from the experimental plant.

Biological studies included the catch and recording of plankton, use of the Sedgwick-Rafter filter, examination of algae, making slides of organisms and sediment examination. Many valuable and interesting papers were presented including "The Place of Plankton in Nature," by W. C. Purdy; "Interpretation and Significance of Bacterial Results," by C. T. Butterfield; "Discussion of Enumeration and Interpretation of B. Coli," by H. W. Streeter; "Tastes and Odors in Water," by W. C. Purdy; "Relation of pH to Volumetric Alkalinity and Acidity," by E. J. Theriault; "Sanitary Surveys," by R. E. Tarbett; "Natural Purification Phenomena," by H. W. Streeter; "The Deoxygenation Formula," by E. J. Theriault; "Typhoid Produced by Shellfish," R. E. Tarbett and H. R. Crohurst.

"Relation of Stream Pollution to Artificial Safeguards: Water Purification," by H. W. Streeter; "Significance of the Oxygen Demand Test," by E. J. Theriault; "Shellfish Sanitation," by R. E. Tarbett; "Recent Phases of Malaria Control," by J. A. Le Prince.

Among those present were Senior Sanitary Engineer, J. A. Le Prince; Sanitary Engineers H. R. Crohurst, L. M. Fisher, J. K. Hoskins, H. N. Old, H. W. Streeter, and R. E. Tarbett; Associate Sanitary Engineers, A. L. Dopmeyer, A. W. Fuchs, E. H. Gage, Leonard Greenburg, I. W. Mendelsohn, A. P. Miller and E. C. Sullivan; Assistant Sanitary Engineer F. J. Moss; Junior Assistant Sanitary Engineers O. C. Hopkins and J. L. Robertson; Technical Assistants C. T. Carnahan, H. D. Cashmore and Chas. T. Wright; Bacteriologist C. T. Butterfield; Special Expert W. C. Purdy; Associate Chemist E. J. Theriault; Dr. M. V. Veldee and Dr. Robert Oleson.

PERSONALS

Walter C. Buetow of Milwaukee has been appointed State Highway Engineer of Wisconsin, succeeding H. J. Kuelling.

L. D. Coles has been made assistant chief engineer of the city of Newark, N. J.

Commander G. A. Duncan of the Navy Civil Engineering Corps has been appointed chief engineer of the Republic of Haiti.

E. C. Nickey, for eighteen years highway engineer of Butler County, Missouri, has resigned, and H. F. Scarborough of Poplar Bluff has been appointed to succeed him.

Herbert J. Leimbach, recently temporarily appointed supervising engineer of the Public Improvement Commission of Baltimore, Md., has been given a permanent appointment.

B. H. Klyce, of Klyce and Harrub, consulting engineers of Nashville, Tenn., died May 23. Mr. Klyce was formerly city engineer of Nashville.

D. W. Roscoe has resigned as assistant city engineer of Fort Collins, Colo., and has taken a position with the engineering department of Cheyenne, Wyo.

R. E. Borrowman has been appointed city engineer of St. Cloud, Minn. From 1924 to 1927, Mr. Borrowman was assistant director of Public Works of St. Petersburg, Fla. He has previously served as city engineer.

Major M. J. Blew, of the Department of Public Works of Philadelphia, has been named to conduct a survey of the Schuykill River, with the object of eliminating objectionable pollution within the city limits.

Mortimer G. Barnes has resigned as chief engineer of the Illinois State Division of Waterways and has been succeeded by L. D. Cornish, assistant chief engineer. Mr. Barnes will act as consulting engineer to the Division.

William R. James, for nearly twenty-three years with the Mueller Co., has formed the William R. James Co., with offices at 50 Church St., N. Y., for the handling of water works and gas equipment, and contractors' supplies.

William J. Cunningham, James J. Hill professor of transportation at Harvard, has been engaged by the committee recently appointed by Secretary Hoover of the Department of Commerce to investigate the changes in economic trends since 1919.

Roy W. Crum, Ames, Ia., has been appointed director of the Highway Research Board of the National Research Council. Mr. Crum served on the Pennsylvania Lines, and as associate professor of Civil Engineering at Iowa State College, of which he was a graduate. Since 1919 he has been Engineer of Materials and Tests with the Iowa State Highway Commission where he has conducted many highway research studies, Mr. Crum has been a member of the Committee on Character and Use of Road Materials since the organization of the Board, and in 1925 he was appointed Chairman of the Culvert Investigation work conducted by the Highway Research Board.

Black & Veatch of Kansas City, and Victor H. Cochrane, consulting engineer of Tulsa, Okla., have been employed as engineers in connection with the 24 million gallon rapid sand filtration plant to be built for the latter city.

George F. Schlesinger, Director of Highways of the State of Ohio, has resigned his position, effective June 15, 1928, and became the chief engineer and managing director of the National Paving Brick Manufacturers Association July 1, 1928. The headquarters of the latter association, which are now in Chicago, will be moved to Washington, D. C.

Mr. Schlesinger was born in Xenia, Ohio, educated in the public schools of that city and graduated from Ohio

ADJUSTABLE MANHOLE TOP

20 MINUTES TO REPLACE OR READJUST WITHOUT DIGGING

Pavement Repairs increase in cost every year. The Adjustable Manhole Top cuts down this expense 90% in cost of replacements.

S. E. T. Valve & Hydrant Co.
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TRUCKS NEVER MIRE ON

FOR IMPASSABLE ROADS

Metalrut is made of heavy gauge corrugated curved troughs, integrally reinforced with rolled edges. The troughs are held in a parallel position by corrugated struts.

Metalrut is built in ten foot sections for easy handling, stacking and laying.

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METALRUT CO., INC.
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State University with the degree of Civil Engineer in 1907. For a number of years he was engaged, principally in railroad engineering. He was a division manager with the Rock Island Lines in Kansas and Missouri for about five years. In the fall of 1913, he became a member of the faculty of Ohio State University in the Department of Civil Engineering and left there during the war for government employment as an engineer on the construction of the Columbus Reserve Depot. He entered the Highway Department as division engineer in the Cincinnati District when A. R. Taylor was commissioner. He was later promoted to chief engineer of construction and resigned during the Herrick administration. When Governor Donahey appointed L. A. Boulay director of highways and public works July 1, 1923, Schlesinger was made state highway engineer. On August 11, 1925, he was appointed to succeed L. A. Boulay as director of highways and public works.

Harry J. Kirk, previously State Highway Engineer, has been appointed Director of Highways of Ohio, succeeding Geo. F. Schlesinger. The position of State Highway Engineer will be filled by promotion from within the department.

A. C. Fensel has been appointed acting director of the Cleveland Municipal Research Bureau following the vacancy caused by the recent resignation of Leyton Carter, who is now secretary of Cleveland Foundation.

V. Bernard Siems has resigned as director, vice-president and general manager of North American Water Works Corporation to become associated, as director and vice-president, with Detwiler & Co., Inc., which handles the financing, engineering and management of utilities.

Lynne J. Bevan, formerly with Viele, Blackwell and Buck, has opened a consulting engineering office at 57 William St., N. Y. He will specialize in hydro-electric projects, stream flow control and utilization for power or water supply, preparation of technical hydraulic evidence, and appraisal of utility properties.

H. W. Dodds has resigned as secretary of the National Municipal League and Russell Forbes was appointed to succeed him, effective July 1. Mr. Dodds will continue as editor of the National Municipal Review, while the administration of the league will be in the hands of Mr. Forbes.

CIVIL SERVICE

Draftsmen (Ship).—Applications for the positions of Chief, Principal, Senior, and Engineering Draftsman (Ship), (Salaries $2,600, $2,300, $2,000 and $1,800) will be received until July 18 to fill vacancies in the Coast Guard.

The duties, with degree of difficulty and complexity varying with the responsibility of the position, are to perform drafting work in connection with the design of and development of plans for ship work; to make necessary computations, prepare estimates, and to perform related work as required.

Competitors will not be required to report for examination at any place, but will be rated on their education, experience, and fitness; and specimens of drawing and lettering to be filed with the application.

Full information may be obtained from the United States Civil Service Commission at Washington, D. C., or the secretary of the United States civil service board of examiners at the post office or customhouse in any city.

Rodman and Chainman.—Applications received until Aug. 31 to fill vacancies in the Bureau of Valuation, Interstate Commerce Commission. Salary $100 per month. Non-assembled examination. One year's experience is required, for which may be substituted high school training. Full information from Civil Service Commission, Washington, D. C., or from Civil Service board at any post office or customhouse.

Engineering Field Aid.—Applications to Aug. 31 to fill vacancies in the field service of the U. S. Geological Survey. The entrance salaries are $75 to $105 per month, and the duties include simple routine technical work incident to topographic and geodetic field surveying. Non-asembled examination. Full information from U. S. Civil Service Commissioner, Washington, D. C., or at civil service boards at any post office or custom house.

TRADE PUBLICATIONS

Municipal Refuse Incineration. Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa. A 24-page booklet discussing municipal refuse disposal in general, and the United States Standard Incinerator in detail.

Specifications for Use of Celite. The Celite Products Co., Los Angeles, Calif., has issued a new specification sheet for architects and engineers covering the use of celite in concrete. Ask for Bulletin 337.

Trade Ethics and Marketing Policies. The International Cement Corporation, N. Y. A 38-page booklet containing a complete statement of the trade ethics and marketing policies under which Lone Star cement is sold.

Ingersoll-Rand Company, New York, has just completed the sixth edition of its 140-page, two-color book: "100 and 1 Ways to Save Money with Portable Compressors." In this book there are given comparative cost data on portable air compressors and air-operated tools (rock drills, paving breakers, clay diggers, backfill tampers, grinders, hoists, riveting hammers, chippers, metal drills, etc.). The information has been put together in handy-reference, cross-index form. In most cases, figures are presented on a manhour basis so that they can be readily applied to local conditions in any part of the world.

Central Foundry Co., N. Y. A 16-page illustrated booklet describing how Universal cast iron pipe was employed in saving Bessemer, Ala., from a water famine which threatened when Hawkins Spring, the source of supply, suddenly went dry. The work involved the laying of 17,000 feet of main in record time.

Ingersoll-Rand Co. N. Y. New bulletins describing rock drills and equipment. 2-color, 8½x 11. Bulletins 4063, drifter drills, 32 pages; 4072, wagon drills, 4 pages; 4159, Little Tugger hoists; 4422, drill steel sharpeners, 32 pages; includes layout of a "practical blacksmith shop."

Austin-Western Road Machinery Co., Chicago, Ill.—In support of the claim that the up-keep of paving is not as much of a dry-as-dust affair as is commonly supposed, this company has distributed an entertaining little book entitled "The Life, Adventures and Death of a Pest." To those who are concerned with the upkeep of highway or city paving, this book will bring an interesting message. Upon receipt of name and address, a copy will be sent promptly.

PUBLIC REPORTS

Maintenance of Way Charges Against Public Carrier Buses, 32 pages. Bulletin No. 85. Iowa Engineering Experiment Station. Presents data on the rates of taxation applied to common carrier buses in Michigan and Iowa and deals with the equitableness of the bus tax systems in the two states, particularly in comparison with the taxes imposed on the automobile. An analysis of the sums that will be required for highway purposes is included to indicate whether present rates of taxation on motor vehicles are likely to provide sufficient funds.

New Jersey Road Map.—Road maps for the year 1928 have been printed by the New Jersey State Highway Commission and may be obtained without cost by those who apply through the mail for them. The communication should be addressed to A. Lee Grover, Secretary of State Highway Commission, Broad Street Bank Building, Trenton. Applicants have been requested to print their names and addresses clearly in order to lessen errors in mailing out the copies.

Numerous changes have been made in the new map and the route numbers of all the highways designated by the Legislature of 1927 for State roads have been listed. This information has been given for the reason that the renumbering made necessary by the statutes is now being carried out.

Separate maps have also been included showing in more detail the streets in and around Camden and Philadelphia and the New York metropolitan area. The density of traffic in the different sections of the State is given by a map with lines of graduated width.

Data for the new map were compiled by William T. Campbell.

NEW CATALOGS

The Barrett Co., N. Y. *Tarvia K-P.* A 16-page ilustrated booklet giving helpful hints for the repair gang foreman.

Alumoyd Sign and Signal Co., Chicago, Ill. An elaborate illustrated folder illustrating traffic problems and discussing their solution.

Sullivan Machinery Co., Chicago, Ill. Bulletin 83-K, describing Sullivan Angle Compound air compressors.

Blaw-Knox Co., Pittsburgh, Pa. A 12-page bulletin (No. 1224) covering steel forms for curb, curb and gutter, and sidewalk construction.

Austin-Western Road Machinery Co., Chicago, Ill. An illustrated folder describing motor graders; another describing leaning wheel graders; another describing road rollers.

Good Roads Machinery Co., Kenneth Square, Pa. An 8-page illustrated catalog describing road rollers.

Hiler Engineering and Construction Co., Brooklyn, N. Y. A 24-page illustrated booklet describing municipal refuse incinerators.

Ingersoll-Rand Co., N. Y. *Important Rock Drilling Projects.* A book of reprints covering a number of important rock drilling jobs.

Orton Crane & Shovel Co., Chicago, Ill. Bulletin No. 56 points out the advantages of the use of heavy duty gasoline engines on locomotive cranes.

Link-Belt Co., Chicago, Philadelphia, and Indianapolis, General Catalog No. 500. 1088 pages, covering chains, sprockets, power transmission, elevating, conveying, engineering data, and prices. In addition to being a catalog, this is really a text-book covering the fields of conveying, elevating and chain transmission.

Irving Iron Works Co., Long Island City, N. Y. An illustrated folder describing Irving continuous floor armoring.

Bay City Dredge Works, Bay City, Mich. Bulletin No. 4 describing the Bay City tractor shovel.

Royer Manufacturing Co., Waterloo, Ia. A 24-page illustrated booklet describing the Hawkeye tilting concrete mixers.

Cleveland Tractor Co., Cleveland, O. Small folders, illustrated in three colors, describing with full specifications, the complete line of Cletracs.

Simplex Ejector and Aerater Corporation, Chicago, Ill., a 48-page illustrated catalog in five sections: describing A, the Simplex patent surface aeration process of sewage treatment; B, the Simplex aerator for water treatment plants; C, the Simplex automatic pneumatic sewage ejector; D, the Simplex sludge pressing apparatus; E, screens, automatic and stationary, hand stops and general fittings.

Koehring Co., Milwaukee, Wis. An illustrated folder describing the Koehring heavy duty concrete paving mixer.

Austin-Western Road Machinery Co., Chicago, Ill. An illustrated folder in colors describing Western Elevating graders; also an illustrated folder in colors describing Western graders and scarifiers; and an illustrated folder in colors describing Western portable screening and crushing plants.

Trico Fuse Mfg. Co., Milwaukee, Wis. Bulletin, 206-B, describing "Powder-Packed" renewable fuses.

C. D. Edwards Mfg. Co., Inc., Albert Lea, Minn., an extra size 32-page catalog, No. 48, marking the 50th anniversary of the company, and describing fully the complete line of graders, drags, scrapers, plows, rooters, culverts, intake grates, rotary snow plows, and other equipment.

Telephone service, a public trust

An Advertisement of the American Telephone and Telegraph Company

THE widespread ownership of the Bell Telephone System places an obligation on its management to guard the savings of its hundreds of thousands of stockholders.

Its responsibility for so large a part of the country's telephone service imposes an obligation that the service shall always be adequate, dependable and satisfactory to the user.

The only sound policy that will meet these obligations is to continue to furnish the best possible service at the lowest cost consistent with financial safety.

There is then in the Bell System no incentive to earn speculative or large profits. Earnings must be sufficient to assure the best possible service and the financial integrity of the business. Anything in excess of these requirements goes toward extending the service or keeping down the rates.

This is fundamental in the policy of the company.

The Bell System's ideal is the same as that of the public it serves—the most telephone service and the best, at the least cost to the user. It accepts its responsibility for a nation-wide telephone service as a public trust.

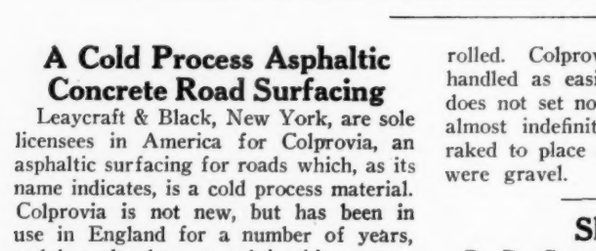
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

A Cold Process Asphaltic Concrete Road Surfacing

Leaycraft & Black, New York, are sole licensees in America for Colprovia, an asphaltic surfacing for roads which, as its name indicates, is a cold process material. Colprovia is not new, but has been in use in England for a number of years, and has also been tested in this country to determine its adaptability to the varying conditions encountered.

Colprovia is a bituminous concrete for which it is claimed that it is easy to handle and place, possesses vitality and wearing qualities, has a smooth and non-skid surface, and is cheaper than any other similar type of road surfacing material that has been evolved. The constituent elements are stone, stone screenings, powdered bitumen and asphaltic oil. Gravel may be substituted for stone if it is properly cleaned and graded; and instead of screenings, sand may be used, with a limestone filler to make up sufficient fine material. For ordinary road jobs, ½ or ¾-inch stone is used. The stone should be of proper quality to meet the standard requirements for asphaltic concrete surfacing. The bituminous materials consist of brittle bitumen and a flux oil of asphaltic base. The bitumen is pulverized in a standard mill of the hammer jaw type to pass a 1-32-inch mesh.



COLPROVIA PAVEMENT LAID IN 1925. Photo 1928

The method of manufacture of the pavement is simple and requires a relatively small and inexpensive plant. No heating is required in the preparation of the bitumen or in the mixing or laying of the manufactured material. Mixing is done in one machine and in one operation. The mixer is of the standard paddle type with especially designed blades. Into it is dumped the aggregate, with sufficient of the asphaltic oil to cover lightly each individual particle. After the aggregate is completely coated, the powdered bitumen is introduced and mixing is continued until the bitumen is uniformly distributed. The entire operation usually requires 2 to 4 minutes.

The material is spread to the depth required (usually about 3 inches) to produce a compacted depth of 2 inches, and rolled. Colprovia, it is claimed, may be handled as easily as anthracite coal; it does not set nor cake and can be stored almost indefinitely. It is shoveled and raked to place on the road as though it were gravel.

Slab Lock

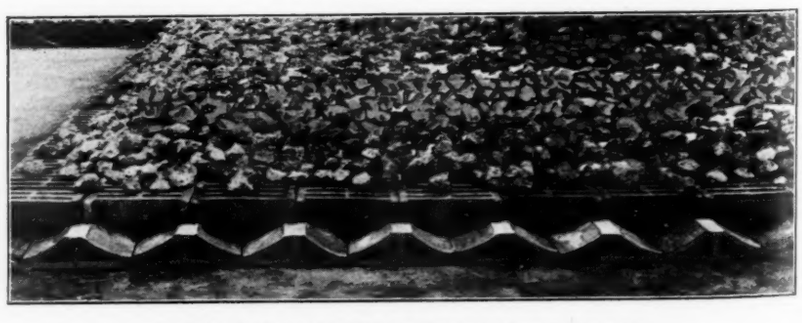
R. D. Gregg, Kankakee, Ill., manufactures a device to prevent the heaving of slabs at transverse expansion joints. The form for the slab lugs is designed to keep the lugs separate and provide free slippage for each lug on its adjacent lug and slab. Each lug is integral with the slab to which it is attached, and is of sufficient cross-sectional area to withstand any shear or cantilever stress that may be caused by heaving or weight of traffic. Its installation does not interfere with placing the concrete or installing expansion strips. For a narrow pavement, two slab locks per joint will be sufficient, one near each edge. For a wide pavement three locks should be used for each joint.

"Metro" Vitrified Filter Floor System

The Metropolitan Paving Brick Co., Canton, O., has developed a system of vitrified channels and grill blocks to form a drainage floor for trickling filters. Among the advantages claimed is cheapness, and rapid and simple construction.

The system consists of vitrified channels which are laid in a mortar bed, mixed 1 to 3. The floor of the filter is struck smooth, and the channels are laid in the mortar bed, the end and bottom joints pointed, and all excess mortar removed. The grill cover blocks are laid closely on the channels.

The strength of the false floor formed in this fashion is claimed to be ample for the load it has to bear. The size and shape of the lateral drains are such as to carry away the effluent rapidly, make flushing possible and effective, and afford plenty of space for air circulation. Due to the ample provision for flushing, removal of particles of filter stone falling through the grill during construction is easy; and the possibility of clogging from unloaded solids or organic growths is negligible. There are no dead areas in the floor, the entire surface acting as a drainage and aerating area.



METROPOLITAN VITRIFIED FILTER FLOOR

Metalayer

The Witt-Humphrey Steel Co., Greensburg, Pa., has developed a metal spraying process, by means of which coatings or linings of molten metal can be applied to any casting, structure or other material it is desired to protect. The coating material, in the form of wire, is fed into the muzzle of the burner, where it is atomized and blown in a fine metal spray onto the surface to be coated, at a velocity of 3,000 feet per second. The sprayed coatings adhere tenaciously and the temperature of the surface being coated is raised but slightly. It is possible to apply sprayed coatings to wood, paper, or delicate fabrics without charring. A single pass of spraying deposits a coating about .002 inch in thickness, and 4 or 5 passes will generally suffice to produce a substantial and impervious coating, just as effective as a greater thickness. The tool used for applying, which weighs only 3½ pounds, is an oxy-acetylene burner combined with a small turbine driven by compressed air at 50 pounds pressure. It is necessary that all articles to be coated are chemically clean and all metal articles should be sand-blasted just prior to coating.

Pipe interiors, cylinders and vessels are coated with a special tool. Small parts and articles weighing up to 10 pounds are handled in a special mass coating machine.

The metals which can be applied by this process include zinc, brass, bronze, selenium, lead, iron and steel, nickel, tin,

copper, cadmium, silver, gold, aluminum, German silver, stainless steel and phosphor bronze.

New Twin-Flex Unit for Ford Model A A Truck

The Twin-Flex Corporation of Detroit and Toronto, is now producing a unit that doubles the capacity at the new Ford AA Truck. The Twin-Flex Unit transforms the Ford truck into a six-wheel, 3-ton vehicle, but it does not change the Ford truck in any essential part and required merely the drilling of four holes in the Ford frame in making the installation.

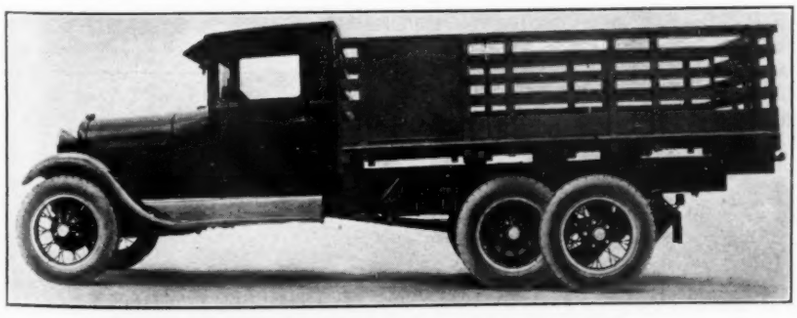
It departs from conventional practice in that the rear or trailer wheels are not in line but are coupled close and overlap the rear wheels of the truck. This, it is claimed, maintains the ease of steering and reduces to a minimum the scuffing of tires in turning sharp corners. This over-lapping wheel construction is also a great advantage over rough ground as the truck will negotiate ruts as readily as an ordinary four wheel vehicle. There is no danger of dropping into a rut and sticking there, since at least two wheels are always on solid ground. This could not be possible if the wheels were placed in line.

Twin-Flex, it is said, will travel anywhere that a Ford Truck will go; turn in the same radius and steer just as easily.

Another feature is the spring suspension, which insures an absolutely equal divison of load under all conditions. The Twin-Flex axle is attached to separate cantilever springs that are exact duplicates of the Ford rear springs except that one-half of each spring lies horizontal and the other half vertical, pivoting on a trunnion at their center. The upper end of the vertical half is connected by a tie bar to a bell crank coupled to the front end of the Ford spring. The springs are thus in compensation at all times. Even though one wheel may be in a rut and the other on a bump there must always be an equal division of the load between springs and axles.

It is claimed by the makers that the individual spring suspension of the Twin-Flex axle, coupled with the over-lapping of the wheels, allows the vehicle to travel the roughest roads, without spring twisting and resulting breakage; and with the use of the dual transmission as supplied by the Ford Company, or other similar device, three ton loads, can be handled with ease and safety, thus materially lessening the cost of motor transportation.

The unit can be applied to the Ford truck in two hours and when once in place becomes an actual part of the truck with none of the appearance of a supplementary attachment. It provides a vehicle that can be depended upon to render the service that would ordinarily be required of a three-ton truck. The essential features of the Twin-Flex Unit are fully protected by patents issued or applied for in all the principal countries.



TWIN-FLEX UNIT FOR FORD TRUCK

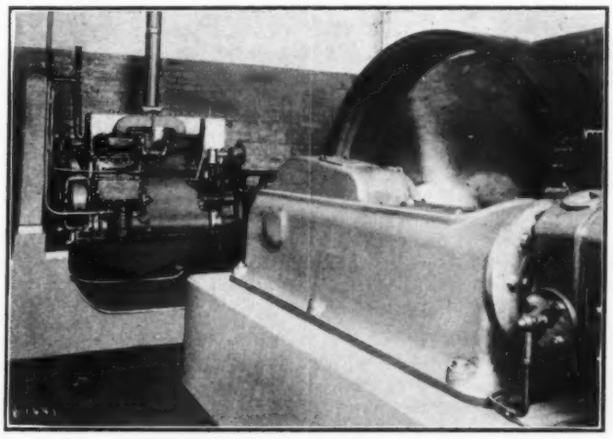
Buda-M.A.N. Diesel Engine

The Buda Company, Harvey, Ill., manufacture the Buda-M. A. N. Diesel Engine under license and patents of the M. A. N. Company, Augsburg, Germany. The illustration shows a horizontal type air compressor driven by a 4-cylinder Buda-M. A. N. Diesel of 6-inch bore and 8-inch stroke operating at 950 r. p. m.

The compressor delivers 400 cubic feet of air per minute against a pressure of 130 pounds per square inch, and the air is used to operate Harris air-lift pumps in a deep well, raising the water from a depth of approximately 167 feet and delivering it to a storage tank. The engine is the full Diesel type, with a normal operating speed of 1,000 r. p. m. and rated at 92 hp. at that speed. The actual brake-horse-power load varies from 80 to 87 h.p.

Fuel with a gravity of 28 to 30 degree Baume is used, and is supplied from the storage tanks through a Niagara meter to a tank mounted on the engine-room wall. From the latter the fuel is fed to the injection pump on the engine by gravity, and a Zenith duplex filter is installed in the line to remove any foreign matter that may be in the fuel. Fuel is injected by the mechanical or solid-injection system, which is under control of the built-in governor. The time of injection can be advanced or retarded manually, and the quantity of fuel regulated, so that the speed of the engine can be controlled manually as well as by the governor. Combustion is complete and efficient, fuel consumption ranges from 0.40 to 0.45 pounds per brake horsepower, and smoke is absent from the exhaust under widely varying loads and speeds.

Lubrication is accomplished by means of a positive gear-driven pump of large capacity, a pressure of 45 pounds per square inch being maintained to all bearings, piston pins, and to the valve gear on each cylinder head. All moving parts are enclosed to promote cleanliness and lubricating oil economy, and a filter cleans all oil before it passes back into the engine.



BUDA-M. A. N. DIESEL ENGINE

Venturex Slurry Agitator

Smith and Smith, Lakewood, O., have recently developed the Venturex slurry agitator, which is a simple device for mixing liquids. Though designed especially for the Portland cement industry, the device is applicable to use with chemicals, paper pulp, oils and other liquids. Its design obtains a circulatory system within the tank through the medium of an internal submerged cylindrical shell. This is possible through a Venturi tube in the place of the cylindrical shell. In its throat is a power driven propeller. The Venturi form is much modified in its lower portion which consists of a cast iron propeller casing bolted to the bottom of the tank. The upper cone is of sheet steel construction stiffened by cast iron rings at either end. The lower ring has guide lugs engaging with guide studs in the fixed base. Annular slots in the cone arranged at the proper heights combine the functions of mixing channels, by reason of the extra currents developed in regular operation; and also serve to maintain the level inside and outside of the Ven-

turi tube when filling the tank or when discharging its contests. The steel cone is raised or lowered by hand or power.

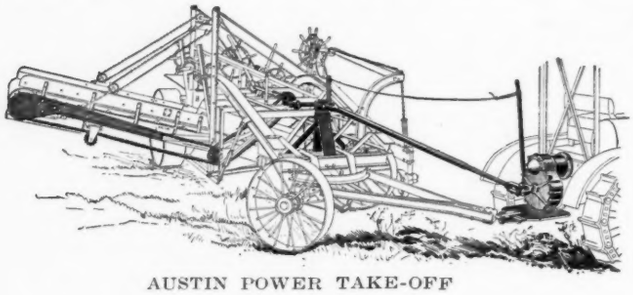
In operation, to fill the tank the steel cone is lifted and the motor started. The propeller is almost at once in action agitating the incoming slurry. When the tank is full the steel cone is dropped during normal agitation. When the tank is to be emptied the steel cone is again raised and the propeller agitates the slurry to the last practical moment.

The self cleaning current of slurry is propelled downward and immediately flares outward like a reversed mushroom. This current sweeps the floor and the lower walls of the tank; then proceeds upward, draws in to the center at the surface, and finally disappears down the upper cone to its beginning at the propeller. The high velocities of the slurry induced by the propeller are most important, because the self cleaning feature of the agitator depends entirely upon high velocities at places where the slurry may deposit. There are no scrapers, plows or similar extraneous means used other than the propeller current, alone.

Investigations have been made to measure the proper current velocities and fix characteristic values in all parts of the tank. Specially designed Piezometer and Pitot tubes were developed for this purpose and thereby the dimensions of all parts of the agitator were accurately determined.

The power required is moderate because, unlike a ship propeller which has a one direction current, the propeller has a continuous circuit. It also has a remarkably small slip, a feature due to its special design.

The only bearing submerged in the slurry is a steady bearing, wholly within the hub of the propeller. It is well protected from the abrasive action of the slurry and is practically a water lubricated bearing. The strong suctive currents, passing outside, carry away the heavy solid particles of the slurry. This bearing has removable cast iron liners, easily replaceable.

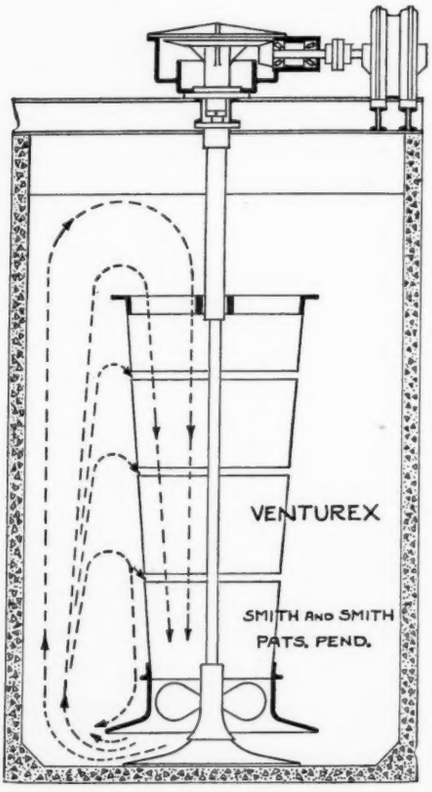


AUSTIN POWER TAKE-OFF

Austin Power Take-Off

The Austin-Western Road Machinery Co., Chicago, Ill., has developed the Austin Power Take-off, a device by means of which the carrier of the Austin "Contractor's Special" New Era Elevating Grader is driven directly from the engine of the "Caterpillar" sixty tractor, not being dependent for its power upon the traction of the rear wheel of the grader.

This device is claimed to provide a faster moving belt; greater capacity; a constant, uniform belt speed, irrespective of the movement of the grader as a whole; a positive drive irrespective of the load put upon the Carrier by the plow; no clogging; uniform delivery of dirt; the ability to start work much sooner after a rain than when the carrier gets its power from the rear wheel; a saving in gasoline, and wear and tear on the tractor, by reason of the decreased load it has to pull—the difference between a six-ton load with one wheel braked until it is nearly locked tight, and the same load with all four wheels running free; a big saving in repairs to the grader by reason of the elimination of wear on the drive wheel, short shaft, gears and other driving mechanism between the rear wheel and the Carrier.



VENTUREX AGITATOR

Farrand Rapid Rule

Hiram A. Farrand, Berlin, N. H., manufactures the Farrand Rapid Rule, which has many valuable properties. It is claimed to be flexible enough so it can be tied in a knot without injury, yet stiff enough to reach 4½ feet without support. It can be wrapped around a pipe or post to measure irregular or angular objects. It is carried in a nickel case about the size of a watch. By starting about 3 inches of the rule out of the case, the remainder, when the check is released, will shoot out automatically. There are no springs, the stiffness of the rule providing its own power. The rule is claimed to withstand hard usage, and may be dropped, thrown about, twisted and distorted, provided it is not forced into a sharper bend than one inch diameter.

FARRAND FLEXIBLE RULE

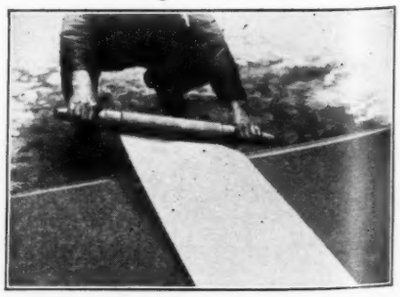
Hand Finishing Belts

The Lakewood Engineering Company of Cleveland, Ohio, has purchased the Walker patents on Hand Finishing Belts, and is supplying these to meet the demand from contractors for a feasible means of giving concrete pavements a final finish, when the screed is not equipped with a mechanically operated belt.

These belts are made of the same material as those used on the standard Lakewood screed. They are, however, intended for use where mechanical methods are not available.

The belt is made of rubberized canvas 18 inches wide and is equipped with wooden handles at each end so that it can be drawn back and forth across the concrete giving that final finish which is to be desired.

Belts are made for any width of road and are carried in stock by all Lakewood Engineering Company representatives.



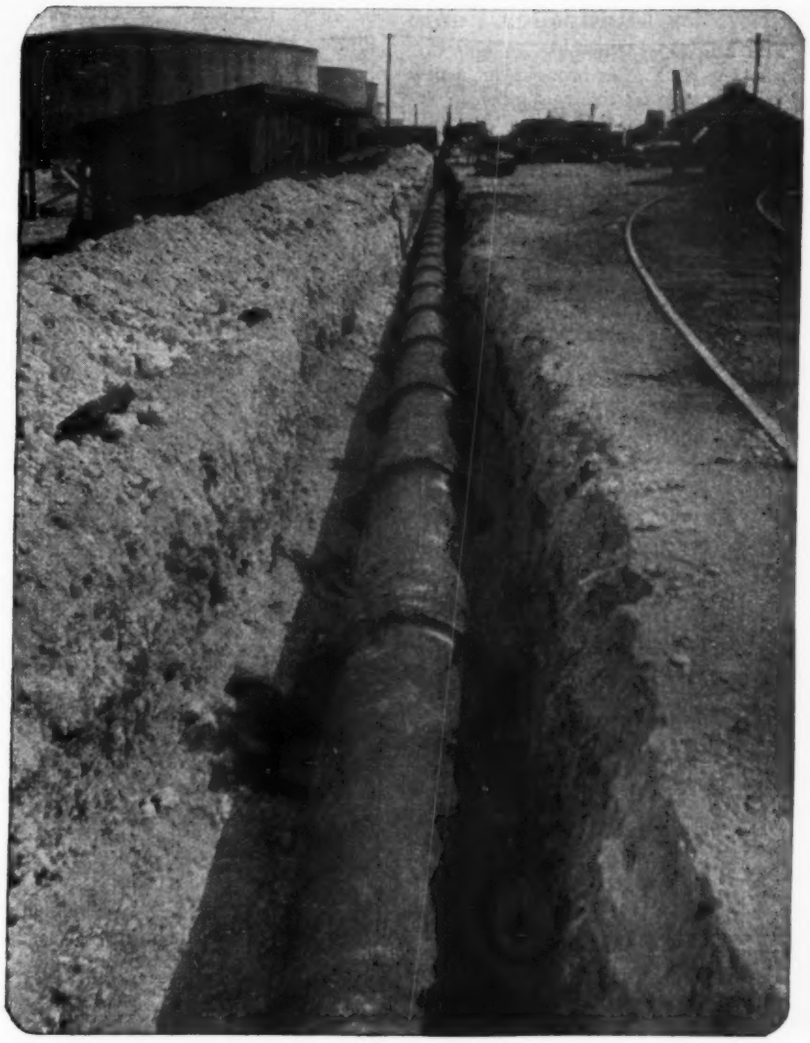
LAKEWOOD HAND FINISHER

Before the pipe is laid

1. You save the cost of wide trenches.
2. You save the cost of digging bell holes.
3. You save buying and handling lead, lead substitutes and all other joint-making materials.
4. You save the cost of all joint-making equipment.
5. You save the cost of high-priced labor.

After the line is laid

6. You are safeguarded against costly repairs and replacements because there is nothing to deteriorate, nothing in the joints to work loose.
7. You are protected against the risk and the inconvenience of leakage.
8. You are assured of water supply and fire protection *without waste.*



Easier Quicker Safer
. . Experienced labor unnecessary

Wrenches—just wrenches—are the only tools needed to lay Universal Pipe. All jointing materials and jointing equipment are eliminated. No lead, no lead-substitutes, no pouring, no calking, no bell holes to dig.

Nothing to deteriorate, nothing to blow out, nothing to work loose in these tight, flexible joints.

The contact surfaces of the hub and spigot ends are machined on a slight differential taper making a natural iron-to-iron joint that amply provides for expansion and contraction, vibration and uneven ground settlement.

Approved by the Underwriters Laboratories which are under the direction of the National Board of Fire Underwriters.

Valves and hydrants of the best known makes are obtainable with the Universal Pipe machined joint.

For water supply, fire protection and other service where freedom from leakage is essential. Easier! Quicker! Safer! Address nearest office.

UNIVERSAL CAST IRON PIPE

No bell holes to dig: No joints to calk

THE CENTRAL FOUNDRY COMPANY

Subsidiary of The Universal Pipe and Radiator Company

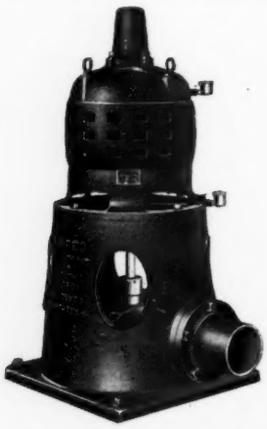
Graybar Building, 420 Lexington Avenue

Chicago Birmingham New York Dallas San Francisco

Luitwieler Multipellor Pump

The Luitwieler Pumping Engine Co., Rochester, N. Y., has brought out a new type of pump, which, it is claimed, requires no lubrication and no bearings. Another important feature claimed is that the pump will deliver varying capacities. No external or manual balancing of runners for capacity or pressure is required as the pump in operation automatically balances the water column and submergence to the well capacity. It is also claimed that this pump has the ability to pump a greater capacity from wells of small diameter.

This pump is designed for wells 4 inches or greater in diameter. It can be operated against a closed outlet, and will



LUITWIELER PUMP

handle clear, sandy, hard or salt water equally well. Rapid deterioration of parts and piping is avoided because no air is pumped into the well. Additional units, with piping, can be added without removing any part from the well. Every section is a complete pump. Capacities are 10 to 2,500 g.p.m.

Anderson Pipe Cutter

The Tucker Co., Inc., New York, N. Y., is distributor for the Anderson pipe cutter, which is made in four sizes to cut pipe 1½-inch to 24-inch; No. 0 cuts from 1½ to 4-inch pipe, inclusive; No. 1 cuts 2 to 8-inch pipe; No. 2 cuts 8 to 16-inch pipe; and No. 3 cuts 14 to 24-inch. It is claimed that this cutter will make a clean cut, taking off 1 inch or more, without starting joints or otherwise disturbing the main. It can be used in an ordinary trench without extra excavating, since the tool is so constructed that cutting is accomplished by turning less than one-quarter way around.

New Adams Scarifier-Grader

J. D. Adams & Company of Indianapolis, Indiana, have recently produced a new 7-foot grader known as the Adams Leaning Wheel Grader No. 31. This machine is furnished with or without scarifier, but it will probably find greatest use as a combination scarifier-grader for townships and counties.

The blade lift and scarifier control gears of the No. 31 are machine-cut, closely housed, and run in oil. The worm gears have special end-thrust bearings adjustable to eliminate end play. The gears are keyed to machine-finished shafts to which are also keyed drop forged lift arms. The lift links for both the blade and scarifier controls are of one-piece, forged-steel construction, having machine-finished ball and socket joints at either end, with split bearings adjustable for wear. The scarifier is raised and lowered by one control and one set of gears with a 4 to 1 spur gear reduction for leverage. The semicircle turns on the reversing circle with no unnecessary clearance and the connections to the moldboard, including pitch adjusting links, are ball and socket fittings which permit no looseness at those points. There is no lost motion in blade control from hand wheels to moldboard and none in the scarifier control. All joints are adjustable for wear, eliminating lost motion.

The No. 31 is of the distinctively rigid, triangular design. In this design an "A" shaped drawbar serves also as the main frame, being connected to the front axle by a ball and socket joint which takes the place of a fifth wheel. The rear end of the drawbar is connected to a "lifting frame" by means of three strong vertical guides on the front side of the frame. The lifting frame rests directly on the rear axle and is supported in its vertical position by two struts between the top of the frame and the front end of the drawbar. The rear end of the drawbar is suspended from and is controlled by the lifting mechanism. The rear member of the drawbar (a 1½ inch square steel bar turning in trunnion bearings) works closely but freely up and down between the vertical guides on the front of the lifting frame. This permits any desired adjustment of the blade as either side of the drawbar may be raised or lowered independently.

This machine has a spring mounted platform which absorbs vibration, a comfortable hinged seat which may be thrown forward out of the way when not in use, equalizing blade lift springs which make blade adjustments easy, and the moldboard has three sets of connections which make it side shiftable 7 inches either way. The adjustable leaning wheels are operated by two simple controls. The frame shifts readily on the long rear axle to provide any desired position to keep the rear wheels out of the discharged dirt. The machine is of riveted construction throughout and is well braced for hard service.

Complete with steerable engine tongue and scarifier, it weighs 3,350 pounds; with wood tongue for horses and without scarifier, it weighs approximately 2,450 pounds. The power recommended is 6 horses or tractor of about 15 drawbar H. P.

Yeomans Rotary Air Compressor

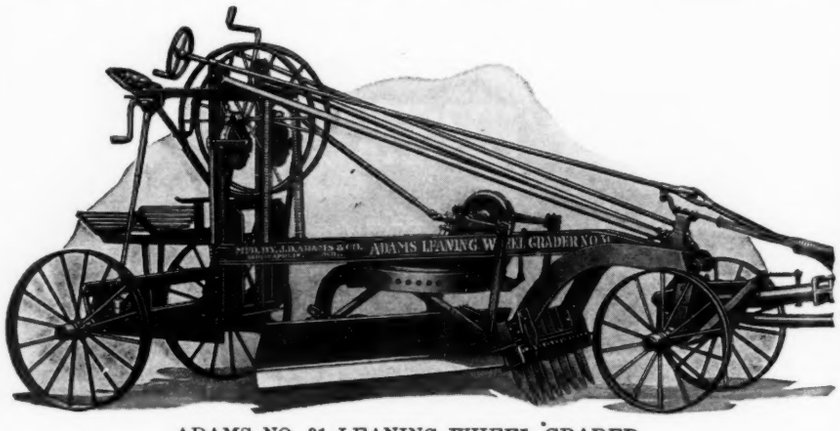
Yeomans Brothers Co., Chicago, Ill., have brought out a new rotary air compressor, which, it is claimed, represents a new development and a step forward in the manufacture of small capacity compressors for relatively high pressures. The new compressor is of the multi-vane type which produces a steady non-pulsating flow of air, and because there is no actual contact between the vanes and interior of the casing, high efficiency and high speed without undue wear are obtainable.

Roller bearings, supporting the rotor, minimize friction losses in the casing and maintain perfect alignment. As neither stuffing boxes with packing nor inlet or discharge valves are used, there is nothing to require adjustment; and because of the simplicity of design, the compressor embodies nothing that can get out of order. Quiet operation is assured by the use of a simple form of muffler on the suction of the compressor.

The casing is of cast iron as is also the rotor which is poured on the shaft to insure against slipping. Vanes are of spring steel carefully ground to exact dimensions. The compressor is direct connected to the unit by a flexible coupling and both compressor and motor are mounted on a substantial cast iron base plate.

Compressors are built in water cooled type for high pressures and air cooled for intermittent service and low pressures. Automatic water control valve can be furnished at slight extra cost.

The compressor is oiled by a Yeomans Automatic Oil Economizer mounted on compressor casing. It lubricates only when compressor is run-



ADAMS NO. 31 LEANING WHEEL GRADER

POWER WHEN YOU NEED IT

TRACKSON
McCORMICK-DEERING

A MASTER Crawler Tractor -- Sturdy and Dependable -- Overcoming ground and weather difficulties -- *Providing power when you need it.*

Meeting emergencies is traditional with Trackson. Its unfailing, unflinching, dependable power easily overcomes every obstacle blocking the way to the quick finish of a job.

Model DH Trackson's rugged construction, coupled with the recognized, reliable McCormick-Deering motor-unit conquers every difficulty. It recognizes no limitations in economical, dependable service.

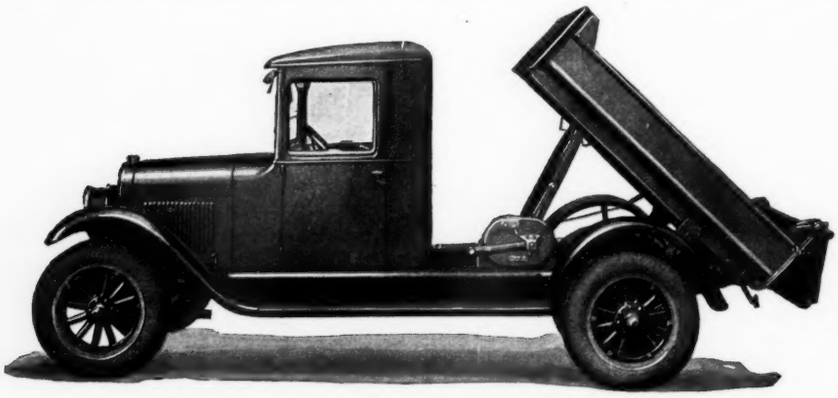
Folder DH gives complete information. Write for it today.

Trackson Company
FULL CRAWLERS AND TRACTOR EQUIPMENT
503 CLINTON ST. MILWAUKEE, WIS.

ning, thus preventing much waste of lubricant.

The Yeomans compressor can be used at pressures up to 50 pounds and in the smaller sizes can be operated at 1,750 r. p. m. with no more noise than that created by the driving motor. The flow of air from the discharge is so steady that ordinary swing check valves can be used without any tendency to flutter. The volumetric efficiency compares favorably with that of reciprocating compressors of like capacity and the mechanical efficiency is likewise high.

These compressors are suitable for use wherever compressed air in small quantities and at moderate pressures is required and, because of their light weight, are well suited for portable use.



WOOD HAND HOIST ON CHEVROLET TRUCK

Wood Hand Hoist

The Wood Hydraulic Hoist and Body Company, Detroit, Mich., has recently brought out the new Wood Hand Hoist, which is claimed to be powerful, efficient and simple in construction. It can be mounted on any chassis having frame length back of cab from 45 to 80 inches.

It has no exposed gears, chains or sprockets. All mechanism is housed in a dust proof case, thus assuring ease in operating, long life and ample lubrication. The method of operation is simple. The motion of the hand crank is multiplied into powerful lifting action by means of a train of four cut steel gears having machined teeth which revolve a cross shaft to which are attached lifting arms connected to the body. Should the crank be released unintentionally, a safety clutch within the gear case prevents the body from lowering under the load. Approximately twenty revolutions are required to secure a body elevation of 45 degrees.

The body is of all steel construction, with rounded bottom corners. Front and rear ends are higher than sides to allow the use of extension sideboards if desired, thus giving ½ cubic yard additional capacity. A structural steel frame on the under side of the body assures rigidity and stiffness under load. Tailgate hooks unlatch automatically while the body is being elevated. Maximum body length is 7 feet; width is 5 feet; body capacities 1, 1½ or 2 cubic yards.

Portable Concrete Surfacer

The Ingersoll-Rand Co., N. Y., has developed a portable concrete surfacer, which has many uses. High spots in concrete roads, which frequently occur on grades and banked curves can be removed at a much lower cost than by hand work. On a recent job on Route No. 11, Illinois State Highway, 30 square feet were resurfaced in 2 hours. The high spot was at a joint, and was 1¾ inches thick at the center, tapering to a feather edge about 1½ feet from the joint.

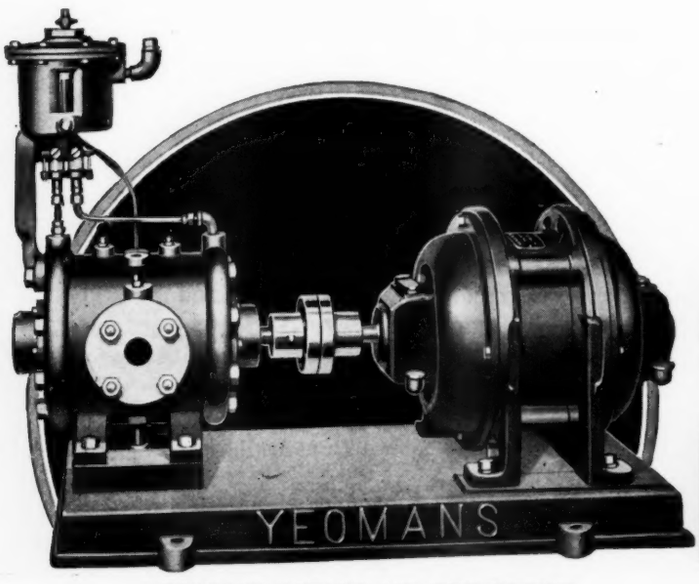
The surface can also be used on concrete floors in building construction. It is especially suited to remove the film or scale which forms on the concrete base; and can be used to make cable ducts. It will cut trenches of the required size and depth in the floor for constructing the ducts.

The surfacer is simple, consisting merely of a special mounting for the Jackhamer drill. It is furnished either with or without the drill.

Improved Economy Double Suction Centrifugal Pumps

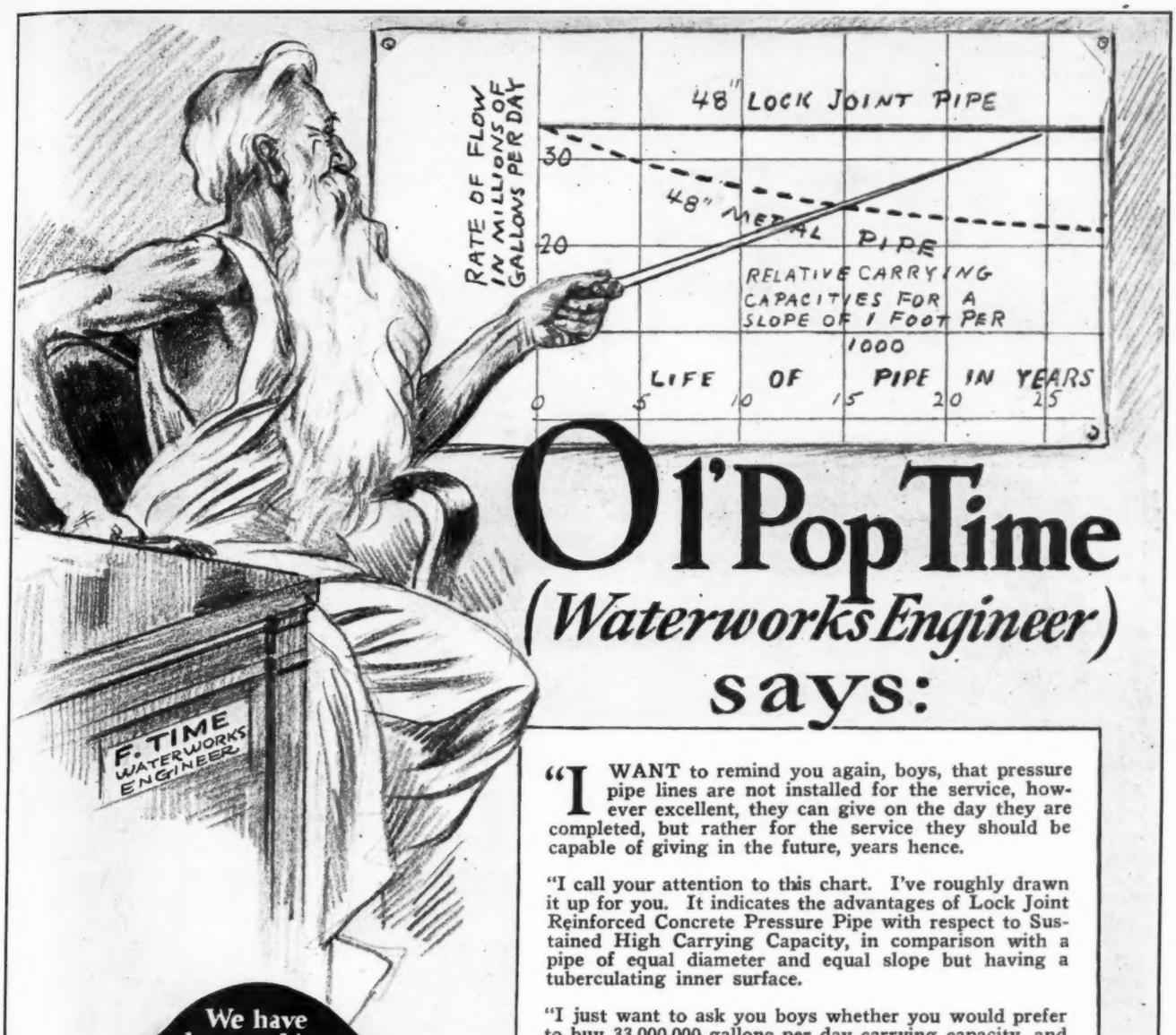
The Economy Pumping Machinery Co., Chicago, Ill., has placed on the market a new line of high efficiency general service centrifugal pumps. These pumps are a redesign of the original Economy double suction line. They contain many refinements both in mechanical and hydraulic design. The makers claim efficiencies over 80 per cent from 800 GPM pumps and still higher efficiencies in larger sizes. The new line is designed for standard motor speeds of 1,750 RPM at 100 ft. head and 1,750 or 3,600 RPM for heads up to 200 ft. These pumps are described in a new bulletin No. 408 which includes very complete selection tables as well as descriptions of details, outline dimensions, etc.

All these single stage pumps are of the horizontal split case design



YEOMANS ROTARY AIR COMPRESSOR

INGERSOLL-RAND SURFACER



Ol' Pop Time
(Waterworks Engineer) says:

"I WANT to remind you again, boys, that pressure pipe lines are not installed for the service, however excellent, they can give on the day they are completed, but rather for the service they should be capable of giving in the future, years hence.

"I call your attention to this chart. I've roughly drawn it up for you. It indicates the advantages of Lock Joint Reinforced Concrete Pressure Pipe with respect to Sustained High Carrying Capacity, in comparison with a pipe of equal diameter and equal slope but having a tuberculating inner surface.

"I just want to ask you boys whether you would prefer to buy 33,000,000 gallons per day carrying capacity, and which will remain at 33,000,000 gallons after many years and decades, or to buy 33,000,000 gallons per day carrying capacity NOW but which will fall off to about 23,000,000 gallons in thirty years or so?"

Send for Hydraulic Charts and Data

LOCK JOINT PIPE COMPANY
Established 1905, AMPERE, N. J.

PRESSURE SUBAQUEOUS SEWER CULVERT

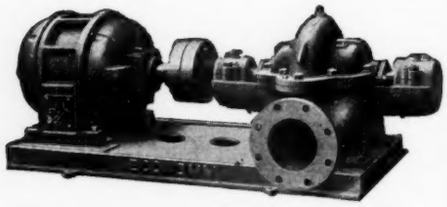
LOCK JOINT
Reinforced
Concrete Pipe

We have been making **SEWER PIPE** for 23 Years!
Today, we have better facilities than ever, with offices and permanent plants in -
Camden, N.J.
Cleveland, O.
Kansas City, Mo.
Chicago Ill.
Denver, Colo.
Transient Plants Wherever Advantageous to Municipalities and Contractors

equipped with sealed type ring oiling bearings. Bearing brackets are cast with the case.

Wearing rings are designed with a male flange which locks them in the case. They are of the ell shape, which takes advantage of the centrifugal action of the water to prevent leakage. Shafts are of alloy steel turned and ground all over. They are protected where exposed to the liquid by cast bronze shaft sleeves held in place with nuts.

Stuffing glands are split and so arranged to deflect any gland leakage into the drip yokes. This refinement



ECONOMY SINGLE STAGE PUMP

is of great assistance in keeping the engine room clean and neat. Larger pumps are equipped with ball thrust bearing. Pumps 3-inch and under are fitted with ground thrust collars.

Light Pierce Roller

The Pierce Roller Co., Anderson, Ind., has brought out a 1½ to 2-ton roller for construction jobs where the use of larger equipment is impractical. Among the many uses for this roller are rolling and packing the crushed stone in filling station drives, parkways and small road jobs; rolling asphalt between street car tracks, rolling lawns, parks, playgrounds, tennis courts, golf courses, and air-ports.

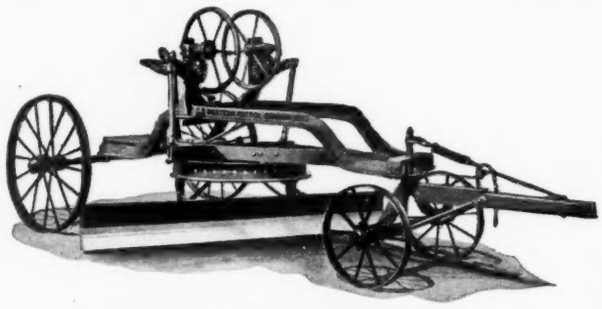
The roller is designed for close work, and will roll up against any curb not over 9 inches high, and within 4 inches of a vertical wall. The road clearance is 9 inches. The roller weighs empty 3,000 pounds; with the rear roller filled with water the weight is 4,000 pounds; and filled with sand 4,500 pounds.

There is one speed forward and reverse, the speed of the roller being regulated by means of the Pierce governor. The motive power consists of a 2-cylinder Continental Red Seal motor of 8 to 12 h. p. The roller is especially economical in operation, using only ½ gallon of gas per hour. The front roller width is 24 inches, and the rear roller 34 inches. Operation is simple and the operator has a clear vision front and rear.

New Western Patrol Grader No. 12

The Austin-Western Road Machinery Co., Chicago, Ill., has recently brought out three new road graders. The No. 12, the lightest of this group, can be handled by two horses on all kinds of work. It has an 8-foot blade.

Like all Western Graders, the No. 12 is hot riveted throughout, except in the very few places where bolts must be used. In placing hot rivets the steel parts to be joined are punched as in ordinary construction. After being placed in the hole, the hot rivet expands under the battering of the air hammer until it completely fills the hole. Then as the rivet cools it shortens and draws together the steel parts far more tightly than a bolt could draw them up. As a result, a hot riveted assembly is proof against vibration and free from slight play.



WESTERN PATROL GRADER NO. 12

The draft beams through which power is transmitted to the blade are 4 inches deep; the circle is the heaviest 5-inch channel made, while the connection between the ends of the circle is the heaviest 8-inch channel made. The circle is 41 inches in diameter which insures steadiness, and also reduces pressure on all contact surfaces.

The balls of the ball and socket joints are drop forgings with heavy bases large enough to be riveted with two ⅝-inch rivets to be the parts holding them.

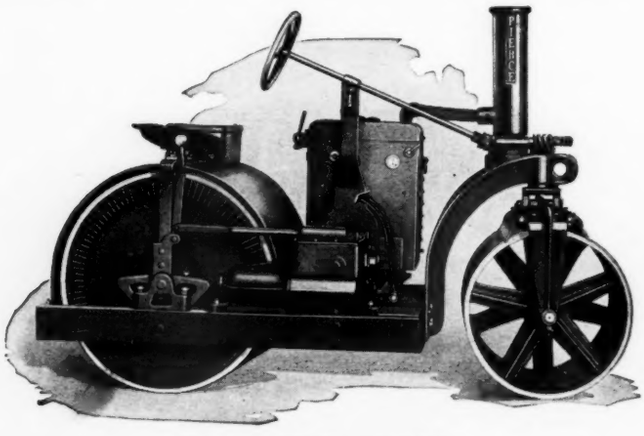
The spokes are hot riveted into both the hubs and the rims, for which reason they will never work loose, or crystallize and break off, while a renewable sleeve placed between the axle and the wheel box forms the bearing for the box and takes all the wear.

The Western No. 12 Grader weighs from 1,200 to 1,350 lbs. depending upon the blade and hitch equipment.

New Hug Roadbuilder Truck Model 86

The Hug Co., Highland, Ill., has recently brought out a new model roadbuilder truck, the model 86. This model is designed to haul the equivalent of two seven-bag batches, 1:2:3½ mix, and has a maximum load capacity of 8,600 pounds. It has a 5-speed forward transmission, and 2-speed reverse. It is claimed that this feature is of great value, in that it provides a range of speed for extra heavy pulling conditions, and also a range of speed for traveling empty on return trip. It can attain a speed of 40 miles an hour in over gear without excessive engine speed, and the engine always operates at maximum efficiency. The model 86 is equipped with a Buda 6-cylinder, heavy-duty truck engine, a double reduction rear axle, full-floating type, and 36x6 tire equipment. The frame is 6-inch I-beam.

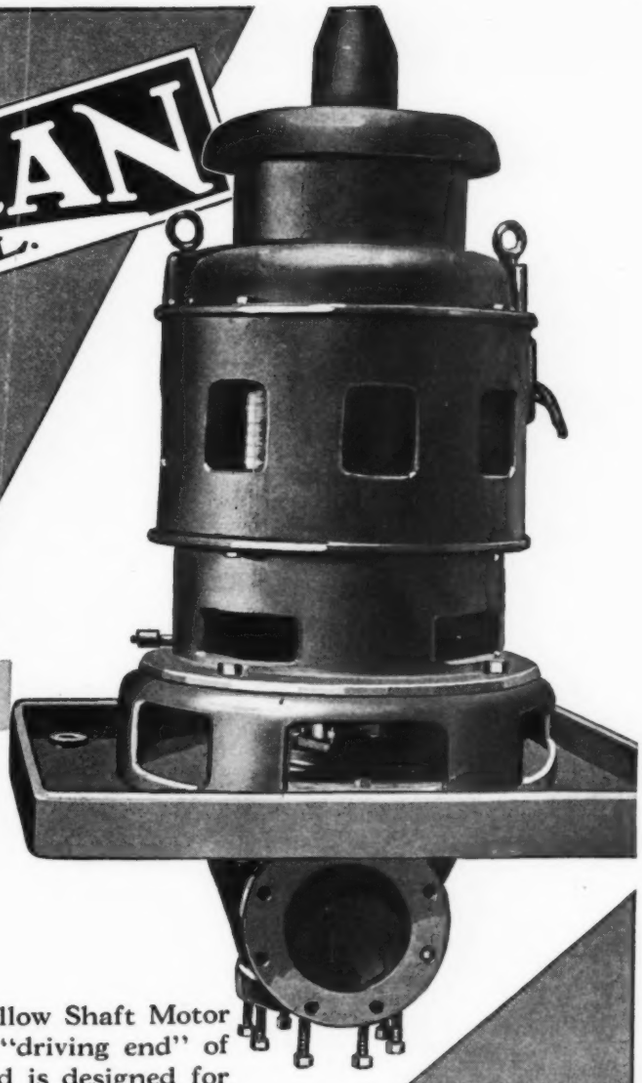
This truck is said to be designed especially for roadbuilding, in which type of design the Hug Company has specialized for the past seven years.



SMALL PIERCE ROLLER

HUG ROADBUILDER TRUCK MODEL 86

AMERICAN
AURORA, ILL.



American Deep Well Turbines

PICTURED ABOVE is an "American" Hollow Shaft Motor Deep well Turbine Head. This is the "driving end" of the "American" deep well turbine, and is designed for use with hollow shaft motors. In this type of head the turbine line shaft extends up through the motor with a driving connection at the top. The pump's thrust load is carried by the top motor bearing, which is designed to carry this extra load. All adjustments are made at the top of the motor. Due to its design, this Turbine Head has the great rigidity necessary to counteract any vibration from the moving parts in the line shaft and pump end of the turbine. The discharge is below the floor. This type of turbine permits an unusually large capacity with relation to the size of the well, and is suitable for use in bored wells from twelve inches and larger inside diameter.

The turbine proper is a special type of vertical centrifugal pump and consists of one or more stages. Impellers are made of bronze and are carefully designed with blades accurately hand finished.

Special engineering bulletin on all types of "American" Deep Well Turbines is available. A copy will be forwarded to you on request.

Branch Offices:

Chicago, Ill.
1615 First Nat. Bank Bldg.
New York, N. Y.
Room 523—165 Broadway
Los Angeles, Calif.
420 East Third Street

District Sales Agencies:

Boston, Mass.	St. Louis, Mo.
Detroit, Mich.	Tulsa, Okla.
Dallas, Tex.	Denver, Colo.
Omaha, Neb.	Birmingham, Ala.
Atlanta, Ga.	Joplin, Mo.
Charlotte, N. C.	El Paso, Texas
Pittsburgh, Pa.	Kansas City, Mo.
Roswell, N. M.	St. Paul, Minn.
Philadelphia, Pa.	Portales, N. Mex.
Salt Lake City, Utah	
San Francisco, Calif.	
Vancouver, B. C., Can.	

THE AMERICAN WELL WORKS

General Offices AURORA, ILLINOIS *and Factory*

INDUSTRIAL NOTES

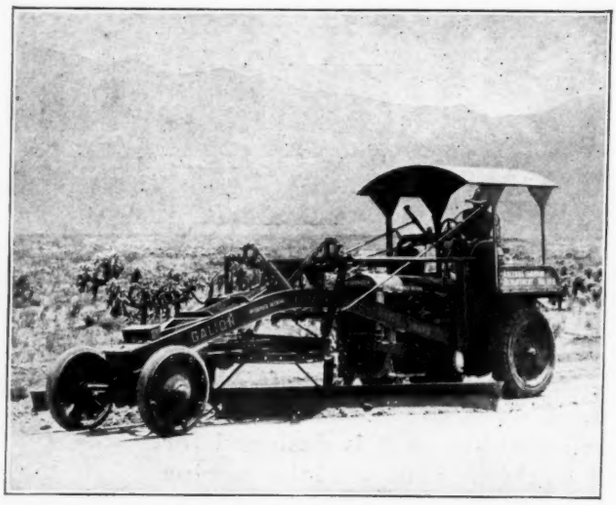
The Galion Iron Works & Mfg. Co., Galion, O., have completed a new brick and steel addition, 90x340 feet, to their factory, which is now claimed to be the largest road machinery plant in the world. The Galion Company manufactures a complete line of rollers, one-man motor patrol graders suitable for use with five different tractors, and straight and leaning wheel graders in all sizes.

ADDITION TO GALION PLANT

The Fulton Iron Works, Kansas City, Mo., has purchased the Foos Engine Co., Springfield, O., and will operate the plant as a branch. The acquisition of the Foos Engine Co. gives the Fulton Iron Works a complete line of Diesel engines ranging from 60 to 2,000 horsepower.

The Bay City Dredge Works, Bay City, Mich., announces the appointment of the following distributors and dealers to handle Bay City tractor shovels, 16-B excavators and model R shovels: Roy Baker, 2816 Brazos Street, Houston, Texas; Lone Star Rd. Machy. Co., 2003 South Akard St., Dallas, Texas; Tobin Machy. & Sup. Co., 705-06 Bldrs. Exch., San Antonio, Tex.; Hooper Equi. Co., 224 No. Alabama St., Indianapolis, Ind.; New England Imple. Co., 19 Jersey St., Boston, Mass.; McWhorter Tractor & Equip. Co., 300 W. Main St., Chattanooga, Tenn.; Gale A. Goss, Durand, Wisconsin; Zimmerman-Wells-Brown Company, Portland, Oregon; Olympic Machy. Co., 134 Intern. Right-of-Way, Spokane, Wash.; Star Machy. Co., 1731 First Ave. South, Seattle, Washington; Midwest Equip. & Sup. Co., 1629 Seventh St., Des Moines, Iowa.

The International Cement Corporation announces the purchase of the Phoenix Portland Cement Company, whose plant is located in Nazareth, Pa., and the Warrior Cement Corporation, whose plant is located at Demopolis, Alabama. These additions to the International System bring the number of plants comprising the System to a total of thirteen, and the total annual productive capacity to 20,000,000 barrels. The Nazareth plant will be operated by the Lone Star Cement Company of Pennsylvania, a subsidiary of the International Cement Corporation, whose principal office will be located in Philadelphia. The Warrior plant will be operated by the Alabama Portland Cement Company, the International subsidiary which now operates the plant at Birmingham, the Warrior plant to be known as Plant No. 2 and the Birmingham plant to be designated as Plant No. 1.



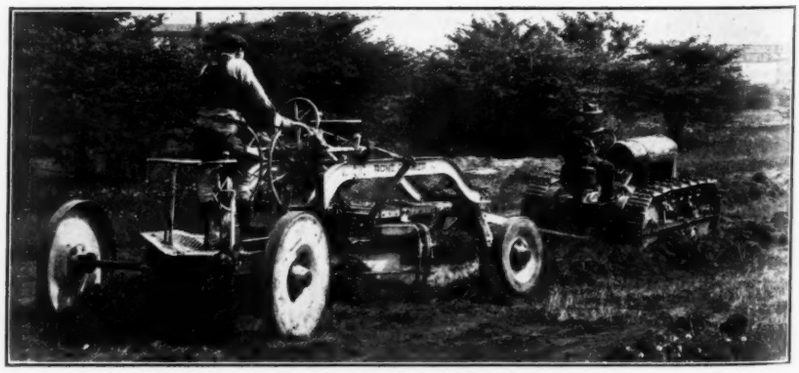
GALION McCORMICK-DEERING ONE MAN MOTOR GRADER ON TUCSON-PHOENIX STATE HIGHWAY, ARIZONA

The Ashland Division of the American Rolling Mill Company has ordered three 300-horsepower oil-electric locomotives to be built jointly by the Ingersoll-Rand Company, General Electric Company and American Locomotive Company.

The Mack-Internatonal Motor Truck Corp. has just made delivery on 60 Model AB 2½ ton Mack trucks, recently ordered by the Highway Department of the State of New York.

The C. O. Bartlett & Snow Company of Cleveland, Ohio, announces the appointment of J. R. Allison, in Pittsburgh, 406 Bessemer Bldg. Mr. Allison is a graduate in mechanical engineering University of Pittsburgh, following which he was field engineer for the Edgewater Steel Co., and for a number of years was in the mechanical department of the Pennsylvania Railroad; he served as first lieutenant in the Engineer Corps during the World War. Since then he has been with the Carnegie Steel Company.

Three new fire boats for Portland, Oregon, have been equipped with the New Viking II six-cylinder Sterling engines. Each boat is driven by two 8-cylinder 565-horsepower Sterling engines at 1200 revolutions, turning a 32-inch diameter 24-inch pitch propeller. These engines are provided with shafts, projecting through the fly wheel and equipped with jaw clutches, permitting connection to centrifugal pumps so that after the boat gets to the fire the propelling engines can be used for pumping. Each boat is also equipped with two 6-cylinder engines arranged for pumping only. The pumping capacity attained 10,000 gallons at 200 pounds pressure. All of this can be put through a 6-inch nozzle. There are also five 3½-inch shore connections at each side of the vessel for taking lines ashore so that this 10,000 gallons can be distributed through ten lines, with valve manipulation. The conditions can be altered to 7,200 gallons at 300 pounds nozzle pressure or 5,200 gallons at 400 pounds.



MODEL DH TRACKSON McCORMICK-DEERING TRACTOR WITH ROME 10-FT. GRADER ON ROAD CONSTRUCTION NEAR MILWAUKEE, WISC.